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THE STANDARD CYCLOPEDIA OF HORTICULTURE

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THE STANDARD CYCLOPEDIA OF HORTICULTURE

A DISCUSSION, FOR THE AMATEUR, AND THE PROFESSIONAL AND COMMERCIAL GROWER, OF THE KINDS, CHARACTERISTICS AND METHODS OF CULTIVATION OF THE SPECIES OF PLANTS GROWN IN THE REGIONS OF THE UNITED STATES AND CANADA FOR ORNAMENT, FOR FANCY, FOR FRUIT AND FOR VEGETABLES; WITH KEYS TO THE NATURAL FAMILIES AND GENERA, DESCRIPTIONS OF THE HORTICULTURAL CAPABILITIES OF THE STATES AND PROVINCES AND DEPENDENT ISLANDS, AND SKETCHES OF EMINENT HORTICULTURISTS

BY

L. H. BAILEY

Illustrated with Colored Plates, Four Thousand Engravings in the Text, and Ninety-six Full-page Cuts

IN SIX VOLUMES

VOL. I—A–B

PAGES 1–602. FIGS. 1–700

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PREFACE

FOURTEEN years ago the present Editor wrote the preface to Volume I of the Cyclopedia of American Horticulture. The purpose of that work was "to make a complete record of the status of North American horticulture as it exists at the close of the nineteenth century;" it was the effort to include "all the species which are known to be in the horticultural trade," together with outlines of "the horticultural possibilities of the various states, territories and provinces," to present biographical sketches of eminent American horticulturists not then living, and in general to discuss the cultivation and handling of horticultural crops. In the preface to Volume IV of that work the Editor expressed the hope that the Cyclopedia would never be revised: "If new issues are called for, mere errors should be corrected; but beyond this, the plates should be left as they are," for it was the purpose of the book that it should stand as a measure of that time. The different volumes have been separately reprinted, but about eight complete re-issues of that Cyclopedia have been made, with such corrections of errors as have been reported; in one restricted edition, published by Doubleday, Page & Co., the same work was bound in six volumes, together with an enlarged preface and a key to the families and genera.

The present Cyclopedia, although founded on the former compilation, is a new work with an enlarged scope. While the older work will no longer be published, it nevertheless stands by itself; and the two should be quoted as independent cyclopedias. The geographical boundaries are wider in the present work, due to the fact that the United States and Canada have both acquired new tropical connections and interests in recent years. It has not been the effort to cover completely the horticultural floras of Porto Rico, Hawaii, and other islands, for that would involve the tropical flora of the globe; but it is the intention to include the most outstanding species grown in a horticultural way in those islands. A fuller treatment has also been given of the plants grown in southern Florida, southern California, and the other southernmost areas of the continental United States.

The treatment in the former Cyclopedia was confined closely to species in "the trade,"—to those plants "sold in the United States and Canada." The present work accepts this basis in general, for the lists of nurserymen, seedsmen, and fanciers indicate very closely the plants that actually are grown, and it would manifestly be impossible as well as undesirable to include all the plants that may be found in botanic gardens, or in the grounds of specialists and amateurs who collect specimens from original sources, or those introduced for purposes of experiment or test or only for scientific study; but "the trade" is interpreted more liberally in this work, to include the offerings of

many European dealers because those dealers supply American customers, to account for species mentioned prominently in European horticultural periodicals as well as in American periodicals, and to insert such plants as are known to be subjects of exchange or to be frequently in cultivation in any region, even though their names may not be found in a commercial list. While it is intended to account for all the species in the trade, it is not intended to name the garden varieties; for the variety lists change too rapidly for discussion in cyclopedic works. The mention of varieties in the leading group-articles is more a matter of record than of recommendation.

Care has been exercised to exclude species that are evidently not now of interest to horticulturists, even though their names may be found in the literature; for the introduction of many dead entries would not only violate the purpose to make a current record, but would make the books too voluminous and would confuse the student with too many names and details. It is desired that the treatment shall be contemporaneous, and that it shall be rescued as far as desirable from the older glasshouse method of transatlantic work. The Cyclopedia aims to account for the plants horticulturally grown within its territory which are now the subjects of living interest or likely to be introduced, to discuss the best practices in the growing of the staple flower and fruit and vegetable crops, to depict the horticultural capabilities of the states and provinces, to indicate the literature of the field, and incidentally to portray briefly the lives of the former men and women who have attained to a large or a national reputation in horticultural pursuits.

The method in the Cyclopedia, in other words, turns about two purposes,—the identification of species, and the cultivation of plants. Both are essential to an understanding of horticulture. The former lends itself readily to usual cyclopedic treatment; the latter expresses itself as a manual of practice. The combination produces an irregular literary product, but it is hoped that the result is not inharmonious.

The cultural details involve special difficulties. The North American continent presents so many conditions that advice for outdoor work cannot be too specific in a work of this kind without leading to serious mistakes. What is advised by a good grower in one place may be contradicted by a good grower in another place. Even in under-glass treatment, in which conditions are largely artificial, difficulties often arise in trying to apply in America the instructions given for European practice. It is not possible for one to grow plants by a book; in this work the cultural details are not directions so much as statements of standard practice: this practice will need to be considerably modified in many cases if the best result for special conditions or objects is to be secured. In the former Cyclopedia the culture was often presented by two persons of unlike experiences for the express purpose of meeting the needs of amateurs; but readers seem to think this to be confusing and the practice has not been followed in the present work. However, special effort has been made to secure the best cultural advice for the plants requiring peculiar or particular handling, and this advice will be found in the discussion of the different crops and plants under their respective heads;

and in addition many practical class-articles have been prepared for the aid of the cultivator and designer. These class-articles are mostly as follows:

Alpine Plants
Annuals
Ants
Aquatics
Arboretum
Arboriculture
Autumn-Gardening
Banks
Basket Plants
Bedding
Bees
Biennials
Birds
Border
Botanic Garden
Bouquet
Bulbs
Conservatory
Culinary Herbs
Cut-Flower Industry
Cuttings
Design, Floral
Diseases and Insects
Drainage
Dwarfing
Evaporating Fruit
Evergreens
Everlastings
Exhibitions
Ferns
Fertilizers
Floriculture
Florists' Plants
Forcing
Forestry
Frost
Fruit-growing
Fungi
Grafting
Grasses
Greenhouse
Hedges
Herbs
Horticulture
Hotbeds and Coldframes
House-Plants
Inspection
Irrigation
Kitchen-Garden
Labels
Landscape-Gardening
Layers
Machinery and Implements
Manure
Market-Gardening
Marketing
Muckland-Gardening
Mushrooms
Nursery
Nut-Culture
Nuts
Orchids
Packages
Palms
Perfumery-Gardening
Pergolas
Planting
Potting
Pruning
Railroad-Gardening
Rock-Gardening
Seeds and Seedage
Storage
Transplanting
Transportation
Vegetable-Gardening
Walks, Drives and Path-
Watering [ways
Windbreaks
Window-Gardening

There is marked growth in outdoor horticulture in North America. The largest extension in the present Cyclopedia, so far as taxonomic work is concerned, is in the description of trees and shrubs. There is widespread interest in these subjects. We are beginning to realize our native resources in woody plants, to understand how to make use of our many climates and natural conditions; and to incorporate freely into our cultivated flora many of the trees and shrubs of China and other regions, under the stimulus of the Arnold Arboretum and other agencies. The resources of the Arboretum have been placed at the command of the Cyclopedia through the careful and original work of Alfred Rehder. Similar aids have been extended from other sources, and particularly from the Foreign Seed and Plant Introduction service of the United States Department of Agriculture.

While hardy plants and outdoor gardening seem to be increasing rapidly in favor, there is a decided tendency toward the breaking-up of large fanciers' collections, in private establishments, of old-time glasshouse plants. It is now quite impossible, for example, to find in this country any large private collections of the species of begonias or of the varieties of camellias or of the show pelargoniums; orchid collections of notable extent are few. The demand of the trade is for relatively few species, and the commercial collections are mostly concerned with a few stock kinds and florists' plants, together with a small addition of annual novelties, rather than with the former long lists of many separate and interesting species and varieties. Even private places, especially private greenhouses, are devoted very largely to cut-flowers and florists' plants. It is incumbent on a cyclopedia of this kind, however, to preserve the accounts of these begonias, orchids, palms, cacti, succulents, "stove plants," and others, even though many of them may be known to very few; and the Editor hopes that the amateur will regain his ascendancy and that collections of plants because they are plants may not perish from amongst us.

There has been great extension in recent years in commercial floriculture and in the

forcing of vegetables. We now think in terms of cropping under glass. The range of species of plants involved in these industries is relatively small, but the areas are large, the business is receiving the attention of able men and women, and the glasshouse industries are making important contributions to the lives of the people. The recent growth of the commercial fruit-growing industry is also notable. Once largely restricted to narrow regions and to "fruit belts," the growing of fruits for market has now assumed the proportions of a great industry comparable with the staple agricultural productions. An effort has been made to catch something of the spirit of all these large efforts, as well as to provide information and advice for the amateur and the home gardener.

When the Cyclopedia of American Horticulture was made, there were few specialists in the systematic botany of cultivated plants. The Editor hopes that the publication of that Cyclopedia has contributed something to the acceleration of interest in this long-overlooked subject. Howbeit, the number of competent specialists, and of those intelligently interested in the subject, is now large enough to have enabled the Editor to cover many of the important groups. The cacti have been placed mostly in the hands of J. N. Rose; a number of tropical plants have been handled anew by W. E. Safford; the orchids, aroids and bromeliads by George V. Nash; euphorbiads by J. B. S. Norton; Citrus and related genera by Walter T. Swingle; Nymphæaceæ by H. S. Conard; the ferns by R. C. Benedict; most grasses by A. S. Hitchcock; special groups by Norman Taylor, chiefly among the composites, palms, and tender araliads; suggestions on cultivated forms and on cultivation have been contributed by C. P. Raffill, of the tropical department, Kew; the survey of families of plants and most of the editorial work on the general introductory key have been in the hands of K. M. Wiegand; and many small groups and special genera have found new treatment by persons who have given them careful study over a considerable period of time. The results of modern scientific studies are now beginning to be positively reflected in the identification of garden plants, and in the advice for the cultivation and handling of horticultural crops and products. With so many persons partaking, it is of course impossible to secure uniformity of taxonomic handling in the various groups, but the gain of having the contributions of specialists will abundantly offset this small technical disadvantage.

And yet, it is true that very much of the work is necessarily compiled from literature rather than constructed from a direct study of the plants themselves. There is no herbarium or other complete and authentic repository of all the species of plants sold by dealers. The best that can be done in very many cases is to accept the name appearing in a catalogue and to attach to it the most authentic or most adaptable description of a recognized botanical species of the same name; there is no telling whether the dealers' plant is properly determined or whether it represents the botanical species bearing the same name. It is impossible now to know how many wrong determinations, inaccurate

and insufficient descriptions, and faulty judgments have been perpetuated from author to author through long series of years. All these matters must be worked out in years to come, when the horticultural plants in the various groups shall have been systematically studied with care. The Editor repeats the hope expressed in the preface written fourteen years ago "that every entry in this book will be worked over and improved within the next quarter century."

Many persons aside from the leading authors have contributed to the enterprise in the most helpful spirit. The Editor's daughter has borne much of the burden of the office and editorial detail. Gardeners, fruit-growers, florists, vegetable-growers, teachers and experimenters, botanists, and the printers, have responded with good fellowship and with something like patriotic pride. Their names will be recorded in the concluding volume; and the public that uses the book will reward them with its gratitude.

Nor should the institutions that have afforded all these persons the opportunities to make their contributions be overlooked. Aside from those agencies already mentioned, the Cyclopedia is under special obligation for the use directly or indirectly of books and collections to Cornell University, the United States Department of Agriculture, the New York Botanical Garden, the Brooklyn Botanic Garden, the Missouri Botanical Garden, the Gray Herbarium, the Royal Botanic Gardens, Kew, the agricultural colleges and experiment stations, and others. Seed merchants, nurserymen, and other commercial establishments of standing, have been very ready with suggestions and help.

Many new illustrations have been added, representing the work of several artists. Most of the new work has been made by B. F. Williamson, New York City; F. Schuyler Mathews, Cambridge, Mass.; Miss M. E. Eaton, of the New York Botanical Garden; Mrs. M. W. Gill, Washington; C. H. L. Gebfert, Boston; and Miss Matilda Smith, of the Royal Botanic Gardens, Kew, England, whose initials will be recognized on the plates of the famous Botanical Magazine. By permission of Professor Sargent, much of the accurate and beautiful work of C. E. Faxon and others in Garden and Forest, a journal that was discontinued more than fifteen years ago and is now out of the market, has been adapted and made available for the present reader; record is made in the text of the pictures of species, at the places where they are used. Some of the work in the old government surveys of the great West has also been brought to the use of the general public.

It is not wholly with satisfaction that one puts forth a work of this magnitude. The responsibility increases with the largeness of the enterprise, for users do not readily purchase new and corrected editions of a work of this extent. Every care has been taken to present an accurate and faithful account, and this is as far as the responsibility can extend. The Editor can not expect to make another cyclopedia of horticulture; but he hopes that these six volumes will comprise another step in the collecting, assorting and appraising of our horticultural knowledge.

L. H. BAILEY.

ITHACA, NEW YORK.
December 30, 1913.

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EXPLANATIONS

The main account of each genus, in large type and separate paragraph for each species, represents the plants probably now in cultivation or at least of major importance.

The "supplementary lists" in smaller type at the end of the articles include names of plants not known to be in the trade but which may be mentioned in horticultural literature, and also such Latin-form names of the trade as are imperfectly understood and cannot be placed under their proper species. These parts are less critical finding-lists of other or extra species.

The Cyclopedia undertakes to account for the species in cultivation within its territory to the close of the year 1912; but in practice the introductions are included to the date of the closing of the different pages.

The size-marks on the illustrations, as (× ⅓), indicate the amount of reduction as compared with natural size, this scale being determined merely by measuring the flat diameter of a drawing and not representing bulk or perspective.

AUTHORSHIP

The practice of the Cyclopedia of American Horticulture in signing the leading and most important articles with the name of the author is here retained. The original author, so far as living or as he has desired, has revised or rewritten his articles for the present work. In very many cases, another person has now revised the articles, and the name of the reviser is indicated by a dagger (†). If the revision has amounted practically to a complete rewriting of the article, the original author's name may not appear, even though some small parts or features of the original article may be retained; this is for the purpose of safeguarding the original author as well as recognizing the work of the present author: the first Cyclopedia stands as the record of its own work.

A name in parentheses, as "(G. W. Oliver)," at the close of a paragraph, indicates that the person is the author of that particular paragraph and of no other in the article. When a person is responsible for more than one paragraph in an article, his part is set off by a separate heading in such a way that it cannot be mistaken.

It is desired to secure experts and specialists for the articles; when this has not been accomplished, the task of revision has fallen to the Editor.

Effort has been made to bring the different parts of the work into as much uniformity of plan and treatment as is possible in an undertaking of this kind; references have been compared; proofs have been submitted to two or more persons in case of difficult or doubtful subjects; and the advice as to cultivation has been checked by practical growers.

NOMENCLATURE

The nomenclature follows in the main the regulations of the "Vienna code," being the principles adopted by the International Botanical Congress held in Vienna in 1905. This code was adopted by the International Horticultural Congress held at Brussels in 1910, with adaptations to horticultural practice. When no combination has yet been made under the Vienna code, the prevailing usage for the particular genus (as expressed in latest monographs) is followed. That is, there is no attempt to reduce all names to one system except so far as combinations have already been made under the international rules, both because a cyclopedia of horticulture is hardly the place in which to make original combinations (except incidentally), and because there is little likelihood that any of the formal systems will have permanency. The subject of nomenclature, and the attitude of the Editor, will be discussed under "Names and Nomenclature" in Vol. IV. Botanical names should not be changed lightly, or for the purpose of regularizing any particular scheme or plan, or to make them always conform to an arbitrary set of rules. Botanical names do not belong to botanists, to do with them as they will. The public has good rights in these names; and this is particularly true in the names of cultivated plants, for they may then have standardized commercial value. The only stability, of course, is usage; and usage can rarely be forced into hard-and-fast regulations. In this Cyclopedia, the interest is in stability of names rather than in priority of names; therefore it accepts the principle of the "nomina conservanda" of the Vienna code, so far as it retains generic names that have been established in general usage for fifty years following their publication, even though the particular names in that list may not have been adopted in every instance.

Not all the changes in names arise from the application of rules of nomenclature. Many of them are the results of taxonomic studies, which make new definitions for genera and species. In this Cyclopedia, there are marked examples of such changes in the citrus genera, in the cacti, and other groups. These changes are to be expected as a result of closer studies of the various groups, of accumulation of specimens from many regions, and the progressive modification of views as to the constitution of genera and species; they are expressions of a living botany. Such changes will be particularly demanded in horticultural plants, for most of these groups have not yet been studied with critical care.

PRONUNCIATION

Attention is called to the fact that the names of genera and species in this work are marked to indicate the accepted pronunciation. The indications are accent marks placed over a vowel. The accent designates (1) stress, or the emphatic syllable, and (2) the length of the emphatic vowel. Following the American custom, as established by Gray and others, a grave accent (ˋ) is employed to designate a long vowel, and an acute accent (ˊ) a short vowel.

Thus *officinàle* is pronounced offici-*nay*-li; *micro-cárpus* is pronounced micro-*cár*-pus. It should be remembered that the final *e* terminates a separate syllable, as *commù-ne, vulgà-re, gran'-de.* This final *e* takes the short sound of *i*, as in *whip.*

Ordinarily in diphthongs the mark is placed over the second letter. Thus, in *aùrea* the *au* is meant to have its customary long sound, as if written *awe.* In *eù-* it has practically the long sound of u, as in *Pseùdo-Quùna, Pseùd-Acàcia.* Double vowels take their customary English sounds, as *ee* and *oo.* Thus, the *oo* in *Hoòkeri* is to be pronounced as in *hook.* In most cases, the letters *oi* (from the Greek, meaning *like to*) are to be pronounced separately: if the *i* is the penultimate syllable (next to the last), it is long, as in *yuccoì-des;* if the *i* is the antepenultimate syllable (third from the end), it is short, as in *rhomboí-dea.* In *dioicus* and *monoicus*, however, the *oi* is a true diphthong, as in *moist.*

These pronunciations follow, in general, the common English method of pronouncing Latin names. However, many of the Latinized forms of substantive and personal names are so unlike Latin in general construction that the pronunciation of them may not follow the rule. As a matter of fact, biological nomenclature is a language of itself thrown into a Latin form, and it should not be a source of regret if it does not closely follow classical rules in its pronunciation of outlying or non-Latin names.

It has seemed best to make an exception to strict literary rules in the case of personal commemorative names in the genitive: we retain, so far as possible, the pronunciation of the original name. Thus, a plant named for Carey is called *Cà-reyi*, not *Carèy-i;* for Sprenger, *Spréng-eri*, not *Sprengèr-i;* for Forbes, *Forbs'-ii*, not *Forbès-ii.* It cannot be expected that uniform consistency has been attained in this matter. It is not always known how the person pronounced his name; and many personal names do not make conformable Latinized words. No arbitrary method of pronouncing personal names is likely to be satisfactory.

It may be well to add what are understood to be the long and short sounds of the vowels:

à as in *cane.*	**ò** as in *cone.*
á as in *can.*	**ó** as in *con.*
è as in *mete.*	**ù** as in *jute.*
é as in *met.*	**ú** as in *jut.*
ì as in *pine.*	
í as in *pin.*	

y is often used as a vowel instead of **i**.

SPELLING

The original spelling of generic and specific names is preferred; that is, the spelling used by the person who made the name. In some cases this original orthography does not conform to the etymology of the name, particularly if the name is made from that of a person. Such a case is *Diervilla*, named for Dierville. Ideally, the name should be spelled *Dierevillea*, but Tournefort and Linnæus did not so spell it.

In accordance with the best authorities, the digraph æ is used in the words cærulea, cærulescens, cæspitosa, cæsia; œ is used in cœlestis and cœlestinum.

The type ligatures æ and œ have been dropped from Latin-made names that have come into the vernacular. Thus, as a common or English name, Spiræa becomes spirea, Pæonia becomes peonia or peony, Brodiæa becomes brodiea, Cratægus becomes crategus.

THE KEYS

There are two groups of keys in the Cyclopedia,—the main key, in Vol. I, to leading families and genera, and the keys to the species in the different genera in all the volumes. The user of the Cyclopedia should forthwith familiarize the method of the keys. Page 79.

To facilitate the study of the plants, the species have been arranged systematically or horticulturally, under the genus, rather than alphabetically; and in large or complex genera, an alphabetical index has been supplied for rapid reference. The grouping of the species is founded preferably on horticultural rather than on botanical characters, so that the arrangement does not always express botanical relationships.

The species-keys are arranged primarily to aid the gardener in making determinations. Every effort is made sharply to contrast the species rather than to describe them. A word of explanation will facilitate the use of the keys. The species are arranged in coördinate groups of various ranks, and groups of equal rank are marked by the same letter. Thus, group A is coördinate with AA and with AAA, and group B with BB and BBB; and the B groups are subordinate to the A groups, and the C groups to the B groups, and so on. Moreover, whenever possible, the coördinate keys begin with the same catchword: thus, if A begins "flowers," so do AA and AAA; and this catchword is not used for keys of other rank. As an example, refer to Abutilon, page 177. Look first at A, beginning "Lvs.," then at AA, also beginning "Lvs." Under AA are the coördinate divisions B and BB, each with "Foliage" for the catchword. Under B there are no subdivisions, but under BB there are divisions C and CC, each with "Fls." for a catchword. Under C there are no subdivisions, but CC has two coördinate divisions, D, DD, each with "Blossoms" for a catchword. Again, D happens to have no division, but DD has the divisions E and EE with "Lf.-blades" as the catchword. In other words, if the plant in hand does not fall under A, the inquirer goes at once to AA. If it falls under AA, then he determines whether it belongs to B or to BB, and so on.

A display of a scheme would stand as follows:

A. Leaves, etc.
  B. Flowers, etc.
    C. Fruits, etc.
      D. Pods, etc.
      DD. Pods, etc.
        E. Seeds, etc.
        EE. Seeds, etc.
    CC. Fruits, etc.
  BB. Flowers, etc.
AA. Leaves, etc.
  B. Roots, etc.
    C. Flowers, etc.
      D. Margins of leaves, etc.
      DD. Margins of leaves, etc.
    CC. Flowers, etc.
  BB. Roots, etc.
  BBB. Roots, etc.
AAA. Leaves, etc.

When the genus is large or the treatment is complicated, the key may be placed separately at the beginning rather than to be divided among the paragraphs; this allows the student to see the entire scheme or plan at once. See Acer, page 196.

ABBREVIATIONS OF BOTANICAL TERMS AND GENERAL EXPRESSIONS

caps.	capsule.
cult.	cultivated, cultivation.
diam.	diameter.
E.	East.
fl.	flower.
fls.	flowers.
fld.	flowered (as few-fld.).
fr.	fruit.
frs.	fruits.
ft.	foot, feet.
in.	inch, inches.
incl.	including.
infl.	inflorescence (cluster).
intro.	introduced.
lf.	leaf.
lft.	leaflet.
lfts.	leaflets.
lvd.	leaved.
lvs.	leaves.
N.	North.
Prop.	propagated, propagation.
S.	South.
segm., segms.	segment., segments.
st.	stem.
sts.	stems.
subfam.	subfamily.
syn.	synonym.
Trop.	tropics, tropical.
var.	variety.
W.	West.
†	reviser (of an article).
∞ (sign of infinity)	numerous, many.

BOOKS AND PERIODICALS

To aid the student in the verification of the work, and to introduce him to the literature of the various subjects, citations are made to the portraits of plants in the leading periodicals to which the American referrer is most likely to have access. These references to pictures have been verified, as far as possible, both in the MS. and in the proof. A uniform and regular form of citation is much to be desired, but is extremely difficult to secure because periodicals rarely agree in methods. It was decided to omit the year in most cases, because of the pressure for space, but the student who lacks access to the original volumes may usually ascertain the year by consulting the bibliographical notes below.

An arbitrary and brief method of citation has been chosen. At the outset it seemed best to indicate whether the cited picture is colored or not. This accounts for the two ways of citing certain publications containing both kinds of pictures, as The Garden, Revue Horticole, and Gartenflora. The figures given below explain the method of citation, and incidentally give some hints as to the number of volumes to date, and of the number of pages or plates in one of the latest volumes.

Standard works on the bibliography of botany are Pritzel's "Thesaurus" and Jackson's "Guide to the Literature of Botany;" also, Jackson's "Catalogue of the Library of the Royal Botanic Gardens, Kew." Rehder's "Bradley Bibliography," a guide to the literature of the woody plants of the world, is invaluable. The Catalogue of the Library of the Arnold Arboretum, Harvard University, now being printed, will afford an excellent guide to the literature of botany, particularly as it relates to woody plants.

A.F. . . . The American Florist. Chicago. A trade paper founded August 15, 1885. The volumes end with July. Many pictures repeated in "Gng." (14:1524=vol. and page.)

A.G. . . . American Gardening. New York. Represents 14 extinct horticultural periodicals, including The American Garden (1888–1890). (20:896=vol. and page.)

B. . . . . The Botanist. Edited by Maund. No years on title pages. Founded 1839. Eight vols., 50 colored plates in each vol. (8:400=vol. and col. plate.) Cumulative index.

B.B. . . Britton & Brown. An Illustrated Flora of the Northern U. S., etc. New York, 1896-98. Ed. 2 in 1913. (3:588=vol. and page of ed. 1; (ed. 2) 3:=vol. and page of ed. 2).

B.H. . . . La Belgique Horticole. Ghent. 35 vols. (1851–1885).

B.M. . . . Curtis' Botanical Magazine. London. Founded 1787. The oldest current periodical devoted to garden plants. The vol. for 1912 is vol. 138 of the whole work. Index to first 107 vols. by E. Tonks. London. (7690=col. plate.)

B.R. . . . Botanical Register (1815–1847). Vols. 1–14 edited by Edwards; vols. 15–33 by Lindley. In vols. 1–23 the plates are numbered from 1–2014. In vols. 24–33 they are numbered independently in each vol. There are 688 plates in vols. 24–33. "An Appendix to the First Twenty-three Volumes" (bound separately or with the 25th vol.) contains an index to the first 23 vols. An index to vols. 24–31 may be found in vol. 31. (1198=col. plate. 33:70=vol. and col. plate.)

B.S.D. . . Bulletin de la Société dendrologique de France. Paris. Founded 1906. One vol. each year. Illustrated. (1907:198=year and page.)

B.T. . . . Britton. North American trees. New York. 1908. All American trees illustrated.

C.L.A.. . . Country Life in America. Founded Nov. 1901. Two volumes a year. (12:75=vol. and page.)

C.O. . . . Cogniaux. Dictionnaire Iconographique des Orchidées. Colored plates, with descriptions. (6=col. plate.)

Em. . . . . Emerson, G. B. Trees and Shrubs of Massachusetts. Boston. 2 vols. 149 plates.

F. . . . . The Florist. London. 1840–1884. (1884: 192=year and page opp. col. plate.) Editors and title pages changed many times. Known as the Florist, Florist's Journal and Florist and Pomologist. Sometimes improperly called British Florist.

F.C. . . . Floral Cabinet Knowles & Westcott. London. 1837–1840. 3 vols., 4to.

F.E. . . . The Florists' Exchange. New York. A trade paper, whose pictures sometimes are repeated in "A. G." Founded Dec. 8, 1888. (11:1298=vol. and page.)

F.M. . . . Floral Magazine. London. Series I. 1861–1871, 8vo. Series II. 1872–1881, 4to. (1881:450=year and col. plate.)

F.R. . . . Florists' Review. Chicago. A trade paper. Vol. 1, Dec. 2, 1897, to May 26, 1898. Two vols. a year (4:660=vol. and page.)

F.S. . . . Flore des Serres. Ghent. (1845–1880.) Inconsistent in numbering, but the plate numbers are always found on the plate itself or on the page opposite. Valuable but perplexing indexes in vols. 15 and 19. 23 vols. (23:2481 =vol. and col. plate.)

F.S.R. . . Flora and Sylva. London. 1903–1905. Edited by W. Robinson. 3 vols. (2:24=vol. and page opposite colored plate. 2, p. 31=vol. and page containing black figure.)

F.W. . . . The Floral World and Garden Guide. London. Edited by Shirley Hibberd. 1858–1880. No plates until 1868. (1875:33=year and col. plate.)

G. . . . . Gardening, Illustrated. London. Founded March 1, 1880. Vols. begin with the March number. (10:25=vol. and page.)

G.C. . . . The Gardeners' Chronicle. London. Series I. (1841–1873) is cited by year and page. Series II or "New Series" (1874–1886), is cited thus: II. 26:824=series, volume and page. Series III is cited thus: III. 26:416. Two vols. a year, beginning 1874. A select index is scattered through 1879 and 1880. Consult II. 12:viii (1879), and similar places in subsequent vols.

G.F. . . . Garden and Forest. New York. 1888–1897. (10:518=vol. and page.)

G.L. . . . Garden Life. London. Incorporates The Gardening World after May 1, 1909. Cited only from vol. 16. (16:54=vol. and page.)

G.M. . . . Gardeners' Magazine. London. Ed. by Shirley Hibberd. Founded 1860. Cited from vol. 31 on. (42:872=vol. and page.)

Gn. . . . . The Garden. London. Founded 1871. Two vols. a year through 1906. Since then one vol. (56:458=vol. and page opp. col. plate. 56, p. 458=vol. and page containing black figure.) An Index of the first 20 vols. was separately published. Complete Index of Colored Plates to end of 1897 in vol. 54, p. 334.

Gng. . . . Gardening. Chicago. Founded Sept. 15, 1892. Vols. end Sept. 1. (7:384=vol. and page.)

Gn. M. . . The Garden Magazine. Garden City, N. Y. Founded 1905. (7:543=vol. and page.)

Gn. W. . Gardening World. Founded 1884. Incorporated after 1909 in Garden Life. (7:118=vol. and page.)

G.O.H. . . Guimpel, Otto & Hayne. Abbildungen der fremden in Deutschland ausdauernden Holzarten. Berlin, 1825. 144 col. plates.

Gt. . . . . Gartenflora. Berlin. Founded 1852. (Gt. 48:1470=vol. and col. plate. Gt. 48, p. 670=vol. and page containing black figure.)

G.W. . . . Die Gartenwelt. Founded 1896. The first year it appeared under the title "Hesdörffers Monatshefte für Blumen- und Gartenfreunde." (13:58=vol. and col. plate. 13, p. 58=vol. and page.)

G.W.H. . . Guimpel, Willdenow and Hayne. Abbildung der deutscher Holzarten. 2 vols. Berlin 1815–20. 216 col. plates.

G.Z. . . . Illustrirte Garten-Zeitung. Founded Oct. 1856. One col. plate in each month. (4:88=vol. and col. plate.)

HBK. . . . Humboldt, Bonpland & Kunth. Nova Genera et Species, etc. Paris. 1815–25. 7 vols. Folio.

H.E. . . . Hooker, Exotic Flora. London, 1823–7. 232 col. plates.

H.F. . . . L' Horticulteur Français. 1st. series 1851–1859. 2nd series 1859–1872. (1853:273= 1st. series, year and col. plate. II. 1860:381 =2nd. series, year and col. plate.)

H.H. . . . Hough, Handbook of Trees of the Northern States and Canada. Lowville, N. Y. 1907. All trees of the region illustrated; all parts of the trees, including bark represented by photographic reproductions.

H.I. . . . . Hooker's Icones Plantarum. London. Founded in 1837. Contains up to 1913 3,000 black plates in 30 vols. The plates with botanical descriptions in Latin.

H.U.. . . . L'Horticulteur Universel. Paris. 1839–1845. 8 vols. with col. plates. The first 6 vols. edited by C. Lemaire. Vol. 7 and 8 called Deuxième and Nouvelle série (7:28=vol. and plate.)

H.W. . . . Hempel and Wilhelm. Bäume und Sträucher des Waldes. Wien, 1889–99. 3 vols. 60 beautiful col. plates and numerous black illustrations in the text (3:45=vol. and col. plate; 3, p. 113=vol. and page containing black figure).

I.H. . . . L'Illustration Horticole. Ghent. (1854–1896.) (43:72=vol. and col. plate.) The volumes were numbered continuously, but there were 6 series. Series I=1854–63. Series II= 1864–9. Series III=1870–80. Series IV =1881–6. Series V=1887–93. Series VI =1894–6. The plates were numbered continuously in the first 16 vols. from 1 to 614: in vols. 17–33 they run from 1 to 619: in series V from 1 to 190: in Series VI they begin anew with each vol. Valuable indexes in vols. 10 and 20. Series V in 4to, the rest 8vo.

I.T. . . . . Icones Selectæ Horti Thenensis. Bruxelles, 1899–1909. 6 vols. with 240 plates. (6:220= vol. and black plate.)

J. . . . . Jardin; journal bi-mensuel d'horticulture générale. Paris. Founded in 1887. (10:36 =vol. and page opp. col. plate; 10, p. 345 =vol. and page containing black figure.)

J.C.T. . . Journal of the College of Science, Imperial University. Tokyo, Japan. Founded in 1886; 33 vols. up to 1913. Contains black plates and figures in the text of plants of E. Asia. (6:3=vol. and plate.)

J.F. . . . . Le Jardin Fleuriste. Ghent. 1851–1854. Edited by C. Lemaire. 4 vols. with 430 col. plates and black figures in the text. (4:421=vol. and col. plate; 4, p. 66=vol. and page containing black figure.)

J.H. . . . . Journal of Horticulture. London. Founded in 1848 as The Cottage Gardener. Series III only is cited, beginning 1880. (III. 39:504=series, vol., page.)

J.H.F. . . Journal de la Société d'horticulture de France. Paris. Founded in 1827 as Annales et Journal de la Société roy. d'horticulture de Paris. Only series IV is cited, beginning 1900. (IV. 1:209=series, vol. and page containing black figure.)

J.H.S. . . Journal of the Horticultural Society of London. Founded in 1846. 9 vols. from 1846–55. A new series started in 1866. The earlier series is cited by the year, the new series by the volume (1846:188=year, page opposite plate; 28:394, fig. 96=vol., page opposite black plate or containing black figure, and fig. in case of several figures.)

L.B.C. . . The Botanical Cabinet. Loddiges. 1817–33. 100 plates in each vol. Complete index in last vol. (20:2000=vol. and col. plate.)

L.D. . . . Loiseleur-Deslongschamps, Herbier général de l'amateur. Paris, 1816–27. 8 vols. with 574 col. plates. There is a second series, 1839–44 in 4 vols. with 309 plates which is very rare and not quoted.

L.I. . . . . Lavallée, Arboretum Segrezianum; Icones selectae. Paris, 1880–5. 36 black plates of trees and shrubs.

Lind. . . . Lindenia. Ghent. Founded 1885. Folio. Devoted to orchids.

Lowe. . . . Beautiful Leaved Plants. E. J. Lowe and Howard. London. 1864. (60=col. plate.)

M. . . . . A. B. Freeman-Mitford. The Bamboo Garden. London. 1896. (224=page.)

M.D. . . . Mitteilungen der Deutschen dendrologischen Gesellschaft. Bonn. Founded in 1892. (1912, p. 161=year and page containing black figure; 1910:1=year and page opp. col. plate.)

M.D.G. . . Möller's Deutsche Gärtner-Zeitung. Erfurt. Founded 1886. (1897:425=year and page.)

Mn. . . . . Meehan's Monthly. Germantown, Philadelphia. Founded 1891. (9:192=vol. and page opp. col. plate.)

Mn.N. . . Meehan. The Native Flowers and Ferns of the United States. Philadelphia. 1878–80. 4 vols. in 2 series (II. 2:3=series, vol. and plate.)

Mx. . . . . Michaux. Histoire des arbres forestiers de l'Amérique septentrionale. Paris, 1810–13. 3 vols. with 138 plates. The English translation under the title The North American Sylva has 156 plates. (3:4=vol. and plate.)

N.D. . . . Nouveau Duhamel. Traité des arbres et arbustes. Paris, 1801–19. 7 vols. with 488 col. plates. The first edition by Duhamel du Monceau was published in 1755 and contains only 250 black plates; the second edition was edited by several botanists and is really an entirely new work. (7:33=vol. and plate.)

O. . . . . Orchis. Beilage zur Gartenflora. (1910:88=year and col. plate. 1910, p. 88=year and page.)

O.R. . . . Orchid Review. London. Founded 1893. (18:169=vol. and plate.)

P.G. . . . Popular Gardening. Buffalo. 1885–90. (5:270=vol. and page.)

P.M. . . . Paxton's Magazine of Botany. London. 1834–49. (16:376=vol. and page opposite col. plate.) Vol. 15 has index of first 15 vols.

R. . . . . Reichenbachia. Edited by Fred. Sander. London. Founded 1886. Folio.

R.B. . . . Revue de l'Horticulture Belge et Etrangère. Ghent. Founded 1875. (23:288=vol. and page opp. col. plate.)

R.F.G. . . Reichenbach. Icones Florae Germanicae et Helveticae. Leipzig. Founded in 1834. 25 vols. with more than 3,000 col. plates issued up to 1913.

R.H. . . . Revue Horticole. Dates from 1826, but is now considered to have been founded in 1829. (1899:596=year and page opp. col. plate. 1899, p. 596=year and page opp. black figure.)

S . . . . . Schneider. The Book of Choice Ferns. London. In 3 vols. Vol. 1, 1892. Vol. 2, 1893. Vol. 3, 1894. (1:390=vol. and page.)

S.E.B. . . Sowerby, English Botany. Ed. 3. London, 1863–1902. 13 vols. with 1952 plates. The first edition was published 1790–1814 in 36 vols. Only the third edition is quoted.

S.H. . . Semaine Horticole. Ghent. Founded 1897. (3:548=vol. and page.)

S.I.F. . . . Shirasawa. Iconographie des essences forestières du Japon. Tokyo. 1900–8. 2 vols. with 161 col. plates. (2:73=vol. and plate.)

S.M. . . . Sargent. Manual of the Trees of North America. Boston and New York, 1905. (810=page containing black figure.)

S.O.B. . . Schmidt. Oesterreich's allgemeine Baumzucht. Wien, 1792–1822. 4 vols. with 240 col. plates. (4:237=vol. and plate.)

S.S. . . . . Sargent. The Silva of North America. 13 vols. Vol. 1, 1891. Vol. 12, 1898. (12:620=vol. and plate, not colored.)

S.T.S. . . . Sargent. Trees and Shrubs. Boston and New York, 1902–13. 2 vols. 200 black plates of trees and shrubs, native and foreign. (2:147=vol. and plate.)

S.Z. . . . . Siebold & Zuccarini. Flora Japonica. Vol. 1, 1835–44. Vol. 2 partly by Miquel, 1845–70. (2:150=vol. and plate.)

V. . . . . Vick's Magazine. Rochester, N. Y. Founded 1878. Vols. numbered continuously through the 3 series. Vols. begin with Nov. (23:250=vol. and page.)

V.F. . . . Vilmorin & Bois. Fruticetum Vilmorinianum. Paris, 1904. (205=page containing black figure.)

V.O. . . . James Veitch & Sons. A Manual of Orchidaceous Plants, cultivated under glass in Great Britain. London. 1887–94.

W.D.B. . . Watson, Dendrologia Britannica. London, 1825. 2 vols. with 172 col. plates (2:160=vol. and plate.)

THE AUTHORS OF BOTANICAL NAMES

By common consent, the Latin name of a plant, in order to be considered by botanists, must first be regularly published by a reputable author in a reputable book or periodical. As an index to this name, the name of its author is published with it whenever an accurate account of the species is given. Thus, "*Berberis aristata*, DC." (p. 490) means that this name was made by De Candolle. This citation at once distinguishes De Candolle's *Berberis aristata* from any other *Berberis aristata*,—for example, from Sims' (p. 492). It is always possible that some other author may have given the same name to some other plant, in which case the older name must stand. In some cases, the fact that there are two plants passing under one name is indicated in the citation: "*Berberis sinensis*, Hemsl., not Poir." (p. 490, nos. 10, 11) means that Hemsley and Poiret applied the name *B. sinensis* to different plants. *B. ilicifolia*, Forst., is not the same as *B. ilicifolia*, Hort. (p. 492, nos. 27, 31); "Hort." means that the particular name is one in use amongst horticulturists,—that it is a garden name.

The citation of authorities gives a clue to the time and place of publication of the species. It is an index to the literature of the subject. It is no part of the idea merely to give credit or honor to the man who made the name. It is held by some that the authority is an integral part of the name, and should always go with it; but common usage dictates otherwise, for the authority is never pronounced with the Latin words in common speech. The authority is a matter of identification, not of language.

Following are the authors most frequently cited in this Cyclopedia:

ADANS. Michael Adanson, 1727–1806. France.

AIT. William Aiton, 1731–1793. England.

AIT. f. William Townsend Aiton, the son, 1766–1849. England.

ALL. Carlo Allioni, 1725–1804. Italy.

ANDERS., T. Thomas Anderson, Director of Botanic Garden in Calcutta.

ANDR. Henry C. Andrews, botanical artist and engraver, conducted The Botanists' Repository from 1799–1811, and illustrated books on heaths, geraniums and roses.

ANDRE. Edward André, 1840–1911, first editor of Illustration Horticole, later editor-in-chief of Revue Horticole.

ANT. Franz Antoine, director of the royal gardens at Schönbrunn, 1815.

ARN. George Arnold Walker Arnott, 1799–1868. Scotland.

ASCHERS. Paul Ascherson, professor of botany, Berlin. 1834–1913.

AUBL. J. B. C. F. Aublet, 1720–1778. France.

AUCT., AUTH. Authors; referring to usage by various or many writers.

BACKH. J. Backhous, English botanist and traveler.

BAILL. H. Baillon, author of the great natural history of plants in French.

BAKER. John Gilbert Baker, formerly keeper of the Herbarium of the Royal Gardens, Kew, England.

BALT. Charles Baltet, frequent contributor to Revue Horticole.

BART. William P. C. Barton, 1787–1856. Pennsylvania.

BARTR. William Bartram, 1739–1823. American botanist.

BATEM. James Bateman, writer and student of orchids. England.

BEAUV. Ambroise Marie François Joseph Palisot de Beauvois, 1755–1820. France.

BECC. O. Beccari, Italian botanist and writer on E. Indian botany.

BECK. Lewis C. Beck, 1798–1853. New York.

BEISSN. L. Beissner, Inspector of the Botanic Gardens at Bonn, and Instructor at Poppelsdorf. Pub. "Handbuch der Nadelholzkunde."

BENTH. George Bentham, 1800–1884, one of the distinguished botanists of England; one of the authors of Bentham & Hooker's "Genera Plantarum."

BENTH. & HOOK. George Bentham and J. D. Hooker authors of "Genera Plantarum." England.

BERGER. Ernst Berger, died 1853. Germany.

BERNH. Johann Jacob Bernhardi, 1774–1850. Germany.

BERT. Carlo Guiseppe Bertero, 1789–1831. Died between Tahite and Chile.

BIEB. Friedrich August Marschall von Bierberstein, 1768–1826. German botanist; lived later in Russia.

BIGEL. Jacob Bigelow, 1787–1879. Massachusetts.

BLUME. Karl Ludwig Blume, born 1796 at Braunschweig, died 1862 at Leyden. Wrote much on Javan plants.

BOIS. Désiré Georges Jean Marie Bois, editor of Revue Horticole. Paris.

BOISS. Edmond Boissier, 1810–1886. Switzerland. Author of "Flora Orientalis" and other works.

BOJER. W. Bojer, 1800–1856, author of a Flora of Mauritius. Austria.

BONPL. Aimé Bonpland. 1773–1858. France.

BORKH. Moritz Balthasar Borkhausen, 1760–1806. Germany.

BR., N. E. N. E. Brown, Royal Botanic Gardens, Kew, England.

BR., R. Robert Brown, born 1773, Scotland, died 1858, London. Author of many important works.

BRIT. Nathaniel Lord Britton, Director of New York Botanical Garden, New York City.

BRONGN. Adolphe Théodore Brongniart, 1801–1876. France.

BUCH.-HAM. Francis Buchanan, later Lord Hamilton, wrote on Indian plants.

BUCKL. Samuel Botsford Buckley, 1809–1884. United States.

BULL. William Bull, plant merchant. London.

BULL. Pierre Bulliard, 1742–1793, author of the great "Herbier de la France" in 12 folio volumes, with 600 plates.

BUNGE. Alexander von Bunge, 1803–1890. Russia.

BURM. Johannes Burmann, 1706–1779, professor at Amsterdam, wrote on plants of Ceylon and Malabar.

BURM. f. Nickolous Laurens Burmann, 1734–1793. Son of Johannes.

CARR. Elie Abel Carrière, 1816–1896, distinguished French botanist and horticulturist, editor of Revue Horticole.

CASP. Robert Caspary, professor of botany at University of Königsberg. 1818–1887.

CASS. Alexandre Henri Gabriel Cassini, Comte de. 1781–1832. France.

CAV. Antonio José Cavanilles, 1745–1804. Spain.

CERV. Vincente Cervantes, 1759(?)–1829. Spanish botanist.

CHAM. Adalbert von Chamisso, poet and naturalist, 1781–1838. Germany.

CHAPM. Alvan Wentworth Chapman, 1809–1899, author of "Flora of the Southern United States."

CHOIS. Jacques Denys Choisy, 1799–1859. Switzerland.

CLOS. Dominique Clos, professor of botany and director of the gardens at Toulouse. Born 1821.

COGN. Alfred Cogniaux, French botanist.

COLEBR. Henry Thomas Colebrooke, 1765–1837. England.

COLLA. Luigi Colla, 1766–1848. France.

COULTER. John M. Coulter, University of Chicago.

CUNN. Richard Cunningham, 1793–1835. Colonial botanist in Australia.

CUNN., A. Allan Cunningham, born 1791, Scotland, died 1839, Sidney, Australia. Brother of Richard.

CURT. William Curtis, 1746–1799. England. Founder of the Botanical Magazine, now known as Curtis' Botanical Magazine.

CURTIS. Moses Ashley Curtis, 1808–1873. North Carolina.

DC. Augustin Pyramus De Candolle, 1778–1841, projector of the Prodromus, and head of a distinguished family. Alphonse De Candolle, the son (1806–1893), and Casimir De Candolle, the grandson, are also quoted in this work.

DECNE. Joseph Decaisne, 1809–1882. France.

D. DON. See Don, D.

DESF. René Louiche Desfontaines, 1750–1833. France.

DESV. Augustin Nicaise Desvaux, 1784–1856. France.

DEVR. Willem Hendrik de Vriese, 1807–1862, professor of botany at Leyden. Wrote on medical plants and plants of the Dutch East Indies.

DICKS. James Dickson, 1738–1822, Scotch writer on flowerless plants.

DIELS. Ludwig Diels, professor of botany, Marburg, Germany.

DILL. Johann Jacob Dillenius, professor of botany in Oxford. 1687–1747.

DIPP. Dr. L. Dippel, of Darmstadt, Germany. Dendrologist; pub. "Handbuch der Laubholzkunde."

DON. George Don, 1798–1856. England.

DON, D. David Don, brother of George, 1800–1841. Scotland.

DONN. James Donn, 1758–1813, author of "Hortus Cantabrigiensis." England.

DOUGLAS. David Douglas, 1799–1834, collector in northwestern America. Scotland.

DRUDE. Prof. O. Drude, of Dresden, Germany.

DRY. Jonas Dryander, 1748–1810. Sweden.

DUCHESNE. Antoine Nicolas Duchesne, 1747–1827. France.

DUMORT. Barthélemy Charles Dumortier, 1797–1878. Belgium.

DUNAL. Michel Felix Dunal, 1789–1856. France.

DUNN. Stephen Troyte Dunn, Kew, England.

DYER. W. T. Thistleton-Dyer, Director of Kew Gardens, 1885–1905, editor of the Flora of Tropical Africa, etc.

EATON, A. Amos Eaton, 1776–1842, author of a "Manual of Botany for North America," 1st ed. 1817; 8th ed. 1841.

EATON, D. C. Daniel Cady Eaton, professor at Yale College, and writer on ferns.

EHRH. Friedrich Ehrhart, 1742–1795. Germany.

ELL. Stephen Elliott, 1771–1830. South Carolina.

ELLIS. John Ellis, 1711–1776. England.

ENDL. Stephan Ladislaus Endlicher, 1804–1849, professor at Vienna. Numerous works.

ENGELM. George Engelmann, 1809–1884. Missouri.

ENGLER. Prof. A. Engler, of Berlin, joint author of Engler and Prantl's "Natürlichen Pflanzenfamilien."

ESCH. Johann Friedrick Eschscholz, 1793–1831. Germany.

FEE. Antoine Laurent Apollinaire Fée, 1789–1874. France.

FENZL. Edward Fenzl, professor and custodian of botanical museum at Wiens, 1808–1879.

FERN. Merritt Lyndon Fernald, assistant professor of botany, Cambridge, Mass.

FISCH. Friedrich Ernst Ludwig von Fischer, 1782–1854. Russia.

FORB. John Forbes, catalogued heaths, willows, conifers, and other plants at Woburn Abbey.

FORSK. Pehr Forskal, 1736–1768, collected in Egypt and Arabia.

FORST. Johann Reinhold Forster, 1729–1798. Germany. (Also Georg Forster, the son.)

FRANCH. A. Franchet, Jardin des Plantes, Paris. 1834–1900.

FRASER. John Fraser, 1750–1811, traveled in America 1785–96. Had a son of same name.

FROEL. Joseph Aloys Froelich, 1766–1841. Germany.

F. v. M. Ferdinand von Mueller, royal botanist of Australia, author of many works on economic plants. See Muell.

GAERTN. Joseph Gaertner, 1732–1791. Germany.

GAGNEP. François Gagnepain. French botanist, writing chiefly on Asiatic plants.

GAUD. Charles Gaudichaud-Beaupré, 1789–1864. France.

GAWL. See Ker.

GMEL. Samuel Gottlieb Gmelin, 1743–1774. Russia.

GOEPP. Heinrich Robert Goeppert, 1800–1884, professor at Breslau. Wrote much on fossil botany.

GORD. George Gordon, 1806–1879, author of the "Pinetum," London, 1858.

GRAEBN. Paul Graebner, professor of botany. Berlin.

GRAY. Asa Gray, 1810–1888, Harvard University, Massachusetts. America's most noted botanist.

GREENM. J. M. Greenman, writes from Harvard University on Mexican plants. Now at the Field Museum, Chicago.

GRIFF. William Griffith, 1810–1845. England.

GRISEB., GRIS. Heinrich Rudolph August Grisebach, 1814–1879. Germany.

HARMS. Prof. Hermann Harms. Berlin.

HASSK. Justus Karl Hasskarl, born 1811. Germany.

HAYNE. Friedrich Gottlob Hayne, 1763–1832, professor at Berlin. Medicinal plants; trees and shrubs.

HAW. Adrian Hardy Haworth, 1772–1833. England.

HBK. Fricdrich Alexander von Humboldt, 1796–1859. Germany. Aimé Bonpland, 1773–1858. France. Karl Sigismund Kunth, 1788–1850. Germany. Authors of a great work on plants of the New World.

HEMSL. W. Botting Hemsley, Keeper at Kew, has written many reviews of genera of horticultural value in The Gardeners' Chronicle and elsewhere.

HENFR. Arthur Henfrey, 1819–1859. English botanist.

HENRY. Augustine Henry, collector of Chinese plants. Cambridge, England.

HENRY, L. Prof. Louis Henry. Writer on woody plants. Paris.

HERB. William Herbert, 1778–1847. England.

HOCHST. Christian Friedrich Hochstetter, 1787–1860, described many African plants.

HOFFM. Georg Franz Hoffmann, 1761–1826. Germany.

HOOK. William Jackson Hooker, 1785–1865. England.

HOOK. f. Joseph Dalton Hooker, the son, 1817–1911. England.

HORT. Hortorum, literally *of the gardens*. Placed after names current among horticulturists, but not necessarily all horticulturists. Often used with less exactness than names of authors. Frequently indicates garden or unknown origin. Many of these plants have never been sufficiently described.

HOST. Nicolaus Thomas Host, 1761–1834. Germany.

JACQ. Nicolaus Joseph Jacquin, 1727–1817. Austria.

JAUB. Hippolyte François de Jaubert. French botanist. Born 1798.

JUSS. Antoine Laurent Jussieu, 1748–1836, the first to introduce the natural families of plants. France.

KARSTEN. Hermann G. K. W. Karsten. German botanist, 1817– .

KARW. Wilhelm Karwinsky von Karwin, collector in Brazil; died 1855.

KAULF. Georg Friedrich Kaulfuss, professor at Halle; died 1830. He described the ferns collected by Chamisso.

KER. John Bellenden Ker, 1765 (?)–1871, botanist, wit and man of fashion. First known as John Gawler. In 1793 was compelled to leave army because of sympathy with French Revolution. His name was changed in 1804 to John Ker Bellenden, but he was known to his friends as Bellenden Ker. First editor of Edwards' Botanical Register.

KER-GAWL. See Ker.

KIRCHN. G. Kirchner, writer of the botanical part of "Arboretum Muscaviense."

KLATT. Friedrich Wilhelm Klatt, a German botanist.

KLOTZSCH. Johann Friedrich Klotzsch, 1805–1860, curator of Royal herbarium at Berlin, monographer of Begoniaceæ.

KOCH. Karl Koch, 1809–1879. Germany.

KOEHNE. Emil Koehne, professor at Berlin. Pub. "Deutsche Dendrologie."

KOMAR. Vlademir Leontyevitch Komarov, writer on plants of eastern Asia. St. Petersburg.

KOST. Vincenz Franz Kosteletzky. Bohemian botanist.

KOTSCHY. Theodor Kotschy, assistant curator at Vienna, 1813–1866. Wrote on oriental plants.

KRÄNZL. F. Kränzlin, Berlin, writes on orchids in The Gardeners' Chronicle.

K. SCH. See Schumann.

KUNTH. See HBK.

KUNTZE. Otto Kuntze. German botanist; chiefly known as a strong advocate of priority in nomenclature. 1843–1907.

LAG. Mariano Lagasca, 1776–1839, one of Spain's most distinguished botanists.

LAM. Jean Baptiste Antoine Pierre Monnet Lamarck, 1744–1829, author of the Lamarckian philosophy of organic evolution. France.

LANGS. Georg Heinrich von Langsdorf, 1774–1852, Russian consul-general in Brazil.

LAUTH. Thomas Lauth, 1758–1826, professor of anatomy at Strassburg, wrote a 40-page monograph on Acer in 1781.

LECQ. Henry Lecoq, born 1802, once professor at Clermont-Ferrand, wrote an elementary botany, a dictionary of botanical terms, a book on hybridization, etc.

LECONTE. John Eaton LeConte, 1784–1860. Pennsylvania.

LEDEB. Karl Friedrich von Ledebour, 1785–1851. Russia.

LEHM. Johann Georg Christian Lehmann, 1792–1860, professor at Hamburg, wrote several monographs, and described many new plants.

LEHM., F. C. F. C. Lehmann, German collector in South America.

LEICHT. Max Leichtlin, horticulturist, Baden-Baden, Germany.

LEM. Charles Lemaire, 1800–1871, works on cacti and botany of cultivated plants. Belgium.

LEVEILLE. Augustine Abel Hector Léveillé, professor of botany, Le Mans, France.

L'HER. C. L. L'Héritier de Brutelle, 1746–1800. France.

LICHTST. August Gerhard Gottfield Lichtenstein, 1780–1851. Germany.

LIND. & ROD. L. Linden and E. Rodigas, once administrator and editor, respectively, of L'Illustration Horticole.

LIND. J. Linden, 1817–1898. Belgium. For many years director of L'Illustration Horticole.

LIND., L. Lucien Linden, associated with J. Linden for some years on L'Illustration Horticole.

LINDL. John Lindley, 1799–1865, one of the most illustrious of English horticulturists.

LINGELSH. Alexander Lingelsheim. Breslau, Germany.

LINK. Heinrich Friedrich Link, 1767–1851. Germany.

LINN. Carolus Linnæus (Carl von Linné), 1707–1778, the "Father of Botany," and author of binomial nomenclature. Sweden.

LINN. f. Carl von Linné, the son, 1741–1783. Sweden.

LIPSKY. Vladimir Ippolitovitch Lipsky, writer chiefly on plants from Central Asia. St. Petersburg.

LODD. Conrad Loddiges, nurseryman near London, conducted Loddiges' Botanical Cabinet from 1817–33, 20 vols., 2,000 colored plates.

LOES. Theodor Loesener, professor of botany, Berlin.

LOISEL. Jean Louis Auguste Loiseleur-Deslongchamps, 1774–1849. France.

LOUD. John Claudius Loudon, 1783–1843, an extremely prolific English writer.

LOUR. Juan Loureiro, 1715–1796, missionary in China. Portugal.

MAKINO. Tomitaro Makino. Tokyo, Japan.

MARSH. Humphrey Marshall, 1722–1801. Pennsylvania.

MART. Karl Friedrich Philipp von Martius, 1794–1868, professor at Munich, monographer of palms, founder of the great Flora Brasiliensis, and author of many works.

MAST. Maxwell T. Masters, late editor of The Gardeners' Chronicle, wherein he has described great numbers of new plants of garden value; author of "Vegetable Teratology," etc. 1833–1907.

MATSUM. Jinzo Matsumuro. Tokyo, Japan.

MAXIM. Karl Johann Maximowicz, 1827–1891, one of the most illustrious Russian systematic botanists; wrote much on Asian plants.

MEDIKUS. Friedrich Casmir Medikus, 1736–1808, director of the garden at Mannheim, wrote a book of 96 pages in German on North American plants in 1792.

MEISN. Karl Friedrich Meisner, 1800–1874. Switzerland.

METT. Georg Heinrich Mettenius, 1823–1866, professor at Leipzig, wrote on flowerless plants.

MEY. Ernst Heinrich Friedrich Meyer, 1791–1851. Prussia.

MEY., C. A. Carl Anton Meyer, 1795–1855, director botanic garden at St. Petersburg, wrote on Russian botany.

MEZ. Dr. Karl Mez, director of the botanic garden at Königsberg; monographer of the bromeliads.

MICHX. André Michaux, 1746–1802. France, but for ten years a resident of North America.

MICHX. f. François André Michaux, the son, 1770–1855. France.

MILL. Phillip Miller, 1691–1771, of Chelsea, England, author of a celebrated dictionary of gardening, which had many editions.

MIQ. Friedrich Anton Wilhelm Miquel, 1811–1871. Holland.

MITFORD. A. B. Freeman-Mitford, English amateur, author of "The Bamboo Garden."

MOENCH. Konrad Moench, 1744–1805. Germany.

MONCH. See Moench.

MOORE. Thomas Moore, 1821–1887, curator of Chelsea Botanic Garden, author of "Index Filicum," and other well-known works.

MOQ. Alfred Moquin-Tandon, 1804–1863. France.

MORR. Charles Jacques Edouard Morren, of Ghent. 1833–1886.

MOTT. S. Mottet, frequent contributor to Revue Horticole, translator of Nicholson's "Dictionary of Gardening."

MUELL. ARG. Jean Mueller, of Aargau, 1828–1896, wrote for De Candolle's "Prodromus," vol. 16.

MUELL., C. Carl Mueller, 1817–1870, who edited vols. 4–6 of Walpers' "Annuals."

MUELL., F. Ferdinand von Mueller, royal botanist at Melbourne, has written much on Australian and economic botany. 1825–1896.

MUHL. Henry Ludwig Muhlenberg, 1756–1817. Pennsylvania.

MURR. Johann Andreas Murray, 1740–1791. Germany.

MURR., A. Andrew Murray, 1812–1878, author of "The Pines and Firs of Japan." London, 1863.

NAUDIN. Charles Naudin, 1815–1899, botanist, frequent contributor to Revue Horticole.

N. E. BR. N. E. Brown describes many new plants in Gardeners' Chronicle. See Br., N. E.

NEES. Christian Gottfried Nees von Esenbeck, 1776–1858. Prussia.

NICHOLS. George Nicholson, curator at Kew, author of "The Dictionary of Gardening." 1847–1908.

NUTT. Thomas Nuttall, 1786–1859. Massachusetts.

O'BRIEN. James O'Brien, current writer on orchids in The Gardeners' Chronicle.

OLIV. Daniel Oliver, once curator at Kew, and founder of the Flora of Tropical Africa.

ORPH. Theodor Georg Orphanides, professor of botany at Athens. Died 1886.

ORTEGA, ORT. Casimiro Gomez Ortega, 1740–1818. Spain.

OTTO. Friedrich Otto, 1782–1856. Germany.

PALL. Peter Simon Pallas, 1741–1811, professor and explorer in Russia. Germany.

PAMPAN. Renato Pampanini, writer on Chinese plants. Florence, Italy.

PAV. See Ruiz. & Pav.

PAX. Ferdinand Pax, professor at Breslau, Germany.

PAXT. Joseph Paxton, 1802–1865. England.

PERS. Christian Hendrick Persoon, 1755–1837. Germany.

PHIL. Rudolph Amandus Philippi, 1808–1904. Santiago, Chile.

PLANCH. Jules Emile Planchon, professor at Montpellier. France. 1833–1900.

POHL. Johann Emmanuel Pohl, 1782–1834, professor at Vienna, wrote a large book on travels in Brazil.

POIR. Jean Louis Marie Poiret, 1755–1834. France.

PRAIN. Sir David Prain, Director of the Royal Botanic Gardens, Kew, since 1905.

PRESL. Karel Boriweg Presl, 1794–1852. Bohemia.

PURSH. Frederick T. Pursh (or Pursch), 1774–1820. Germany, but for twelve years in the United States.

RADDI. Guiseppe Raddi, 1770–1829. Italy.

RAF. Constantino Samuel Rafinesque-Schmaltz, 1784–1842. Professor of Natural history, Transylvania University. Lexington, Kentucky.

R. BR. Robert Brown, born 1773, Scotland, died 1858, London. Author of many important works.

REGEL. Eduard von Regel, 1815–1892, German, founder of Gartenflora; Director Botanic Garden at St. Petersburg.

REHD. Alfred Rehder, Arnold Arboretum, Massachusetts.

REICHB. Heinrich Gottlieb Ludwig Reichenbach, 1793–1879. Germany.

REICHB. f. Heinrich Gustav, 1823–1889, son of the preceding. Orchids.

RICH. John Richardson, 1787–1865. Scotland.

RICHARD. Louis Claude Marie Richard, 1754–1821. France.

RIDDELL. John Leonard Riddell, 1807–1865, professor of chemistry in Cincinnati and New Orleans.

ROB. B. L. Robinson, Director Gray Herbarium of Harvard University, is editing "The Synoptical Flora of North America."

ROD. Emile Rodigas, for some years connected with L'Illustration Horticole.

RODR. J. B. Rodrigues, Brazilian botanist, writer on palms and Brazilian botany.

ROEM. Johann Jacob Roemer, 1763–1819. Switzerland. Also M. J. Roemer.

ROSCOE. William Roscoe, 1753–1831. England.

ROSE. J. N. Rose, assistant curator, United States National Herbarium, Smithsonian Institution. Mexican plants.

ROTH. Albrecht Wilhelm Roth, 1757–1834. Physician at Vegesack, near Bremen.

ROXBG. William Roxburg, 1759–1815. India.

ROYLE. John Forbes Royle, born 1800, at Cawnpore, died 1858 London. Professor in London. Plants of India.

RUIZ. & PAV. Hipolito Ruiz Lopez, 1764–1815, and José Pavon, authors of a Flora of Peru and Chile. Spain.

RUPR. Franz J. Ruprecht, 1814–1870. Russia.

RYDB. Per Axel Rydberg. New York Botanical Garden.

S. &. Z. See Sieb. & Zucc.

SABINE. Joseph Sabine, 1770–1837. England.

SAFFORD. W. E. Safford, United States Department of Agriculture, Washington.

SALISB. Richard Anthony Salisbury, 1761–1829. England.

SALM-DYCK. Joseph, Prince and High Count Salm-Reifferscheidt-Dyck, born at Dyck, 1773, died 1861. Wrote on Aloe, Cactus, Mesembryanthemum.

SARG. Charles Sprague Sargent, Director Arnold Arboretum, author of "Silva of North America."

SAV. L. Savatier, writer on Japanese plants.

SAVI. Gaetano Savi, died 1844. Italy.

SCHEIDW. Michael Joseph Scheidweiler, 1799–1861, professor of botany and horticulture at Horticultural Institute of Ghent.

SCHK. Christian Schkuhr, died 1811. Germany.

SCHLECHT. Diedrich Franz Leonhard von Schlechtendahl, 1794–1866. Professor at Halle, wrote several memoirs in Latin and German.

SCHNEID. Camillo Schneider, author of "Handbuch der Laubholzkunde." Vienna.

SCHOTT. Heinrich Wilhelm Schott, 1794–1865. Wrote much on aroids with Nyman and Kotschy.

SCHRAD. Heinrich Adolph Schrader, 1767–1836. Germany.

SCHULT. Joseph August Schultes, 1773–1831. Germany.

SCHUM. Christian Friedrich Schumacher, 1757–1830. Germany.

SCHUMANN. Karl Moritz Schumann, 1851–1904, professor of botany, Berlin. Wrote much on Cactaceæ.

SCHUR. Philipp Johann Ferdinand Schur, 1785–1848. Germany.

SCHW., SCHWEIN. Lewis David von Schweinitz, 1780–1834. Pennsylvania.

SCHWEINF. George Schweinfurth. Germany. Born 1836.

SCHWER. Graf Fritz von Schwerin, German authority on Acer.

SCOP. Johann Anton Scopoli, 1723–1788. Italy.

SEEM. Berthold Seemann, Hanover, 1825–1872. Wrote on palms, and botany of the voyage of the *Herald*.

SIBTH. John Sibthorp, 1758–1796, author of a Flora of Greece. England.

SIEB. & ZUCC. Philipp Franz von Siebold, 1796–1866, and Joseph Gerhard Zuccarini, 1797–1848. Germany.

SIMS. John Sims, 1792–1838. England, for many years editor of Curtis' Botanical Magazine.

SMALL. John Kunkel Small. New York Botanical Garden.

SMITH. James Edward Smith, 1759–1828. England.

SOLAND. Daniel Solander, 1736–1782. England.

SPACH. Eduard Spach, born 1801 Strassburg, died 1879. Author of "Histoire Naturelle des Vegetaux."

SPAETH. L. Spaeth, Berlin, nurseryman, died 1913. H. L. Spaeth, the present head of the firm.

SPRENG. Kurt Sprengel, 1766–1833. Germany.

STEUD. Ernst Gottlieb Steudel, 1783–1856. Germany.

STEV. Christian Steven, 1781–1863. Russia.

ST. HIL. Auguste de Saint Hilaire, 1779–1853. France.

SWARTZ. Olof Swartz, 1760–1818. Sweden.

SWEET. Robert Sweet, 1783–1835, author of many well-known works, as "Geraniaceæ," "British Flower Garden."

SWINGLE. Walter T. Swingle, United States Department of Agriculture, Washington.

TAUSCH. Ignaz Friedrich Tausch. Died 1848. Austria.

TENORE. Michele Tenore, 1780–1861. Italy.

THORE. Jean Thore, 1762–1823, physician at Dax.

THUNB. Carl Peter Thunberg, 1743–1822, wrote "Flora Japonica" (1784). Sweden.

TOD. Augustino Todaro, director of the botanic gardens at Palermo. 1818–1892.

TORR. John Torrey, 1796–1873. New York.

TRAUTV. Ernst Rudolph von Trautvetter.

TREL. William Trelease, professor of botany, University of Illinois.

TUCKM. Edward Tuckerman, 1817–1886. Massachusetts.

TURCZ. Nicolaus Turczaninow. Died 1864.

UNDERW. Prof. Lucien M. Underwood, Columbia University, New York, N. Y., has written much on ferns, etc.

URBAN. Ignatius Urban, of the Köngl. Bot. Garten, near Berlin, writer on Brazilian and West Indian plants.

VAHL. Martin Vahl, 1749–1804. Denmark.

VAN HOUTTE. Louis Van Houtte, 1810–1876, founder and publisher of Flore des Serres.

VEITCH. John Gould Veitch, 1839–1867, and successors, horticulturists at Chelsea, England.

VENT. Etienne Pierre Ventenat, 1757–1808. France.

VERL. B. Verlot, contributor to Revue Horticole.

VERSCH. Ambroise Verschaffelt, 1825–1886, founder and publisher of L'Illustration Horticole at Ghent, Belgium.

VILL. Dominique Villars, 1745–1814. France.

VILM. Several generations of the family of Vilmorin, Paris, seedsmen and authors of many books and memoirs on botany and horticulture. Pierre Philippe André Leveque de Vilmorin, 1746–1804. Pierre Vilmorin, 1816–1860. Henry L. de Vilmorin, died 1899.

VOSS. A. Voss, author of botanical part of Vilmorin's Blumengärtnerei.

WAHL. Georg Wahlenberg, 1781–1851. Sweden.

WALDST. Franz Adam, Graf von Waldstein, 1759–1823. Austria.

WALL. Nathanael Wallich, born 1786, Copenhagen, died 1854 London. Wrote on plants of India and Asia.

WALP. Wilhelm Gerhard Walpers, 1816–1853.

WALT. Thomas Walter, about 1740–1788, author of "Flora Caroliniana." South Carolina.

WANG. Friedrich Adam Julius von Wangenheim, 1747–1800. Germany.

WANGN. Walter Wangerin, monographer of Cornaceæ. Germany.

WARSCZ. Joseph Warscewicz, 1812–1866.

WATS. Sereno Watson, 1826–1892. Harvard University.

WEB. Friedrich Weber, 1781–1823. Germany.

WEDD. H. A. Weddell, wrote for De Candolle's "Prodromus," vol. 16, etc.

WELW. Friedrich Welwitsch, 1806–1872.

WENDL. Hermann Wendland, Director Royal Botanic Garden at Herrenhausen, one of the chief writers on palms.

WIGHT. Robert Wight, writer on Indian plants. 1796–1872.

WILLD. Karl Ludwig Willdenow, 1765–1812. Germany.

WILSON. Ernest H. Wilson, collector of Chinese plants.

WITH., WITHER. William Withering, 1741–1799. England.

WITTM. Max Karl Ludwig Wittmack, editor of Gartenflora. Professor at Berlin.

WOOD. Alphonso Wood, 1810–1881. Of his "Class-Book of Botany," 100,000 copies have been sold in America.

ZABEL. Hermann Zabel, writer on woody plants, 1832–1912. Germany.

ZUCC. Joseph·Gerhard Zuccarini, 1797–1848, professor at Munich.

The Standard Cyclopedia of Horticulture

A SYNOPSIS OF THE PLANT KINGDOM

By KARL M. WIEGAND

Most modern botanists, as well as zoölogists, now think that organisms have descended, through the ages, from ancestors which differed in many ways and often markedly from the present organisms, but were in general of a less specialized type. It is, indeed, thought that the original life was of an exceedingly simple nature, and that during the countless ages its descendents have gradually diverged from one another much as the branches of a tree diverge from its trunk, until we have the enormous wealth of species and extreme diversity, and great complexity of structure exhibited by the plants and animals existing today. Just as through descent in the human race we have groups of individuals called families, the members of which are more closely related to each other by descent than to other individuals, so we have groups of related species and genera forming similar natural families. The attempt of the so-called systematic botanist of the present day is to interpret the evolutionary history of plants, to discover these natural families, and to represent this knowledge of history and relationship in a synopsis of the plant kingdom. Such a synopsis, therefore, attempts to show an actual "blood relationship,"—the real genealogy of the plant kingdom. Before the theory of evolution became widely accepted as a result of Darwin's labors, systems of classification were either wholly arbitrary, and planned simply for convenience in dealing with the vast number of existing organisms (e.g., the sexual system of Linnæus), or they were based on the morphological relation of the flower to a certain floral plan. Since, however, the floral plan depends largely on descent, these last-named systems often accidentally approached in many respects very closely to the natural systems based on evolution. Instead of placing the "highest" types of plants (the most recent) last in their classification, as is now done, the idealists placed them first,—hence the Ranunculaceæ, with parts separate and hypogynous, and therefore most ideal, is found first in such a classification. The fusion of parts in the Compositæ, and the union of parts in the Gamopetalæ were thought to represent a less perfect condition. Likewise, the Apetalæ, with parts lacking, were still less perfect, and therefore were placed later. The Gymnosperms were somewhat arbitrarily placed next, followed by the Monocotyledons, in which the grasses were placed last. These in turn were followed by the ferns and the lower groups. This was the system used in Bentham and Hooker's "Genera Plantarum," a great work which, notwithstanding the change in system, is still a standard authority in descriptive botany.

In the system adopted for the present synopsis, that used by Engler and Prantl in the great German work, "Die Natürlichen Pflanzenfamilien," the sequence is from the most primitive and the most ancient toward the most specialized and most modern,—from the lower algæ to the fungi, mosses, liverworts, ferns, gymnosperms, and flowering plants. Here the Monocotyledonous line culminates in the highly specialized Orchidaceæ, and the Dicotyledonous line in the equally specialized Compositæ. These two families, therefore, are now thought to represent the present culmination of nature's handiwork in the two great lines of development in flowering plants.

In the present synopsis of the Pteridophyta and Spermatophyta, the treatment of large groups, sequence of families and family limits, is, except in a few cases, that of our most recent great work edited by Engler and cited above. Among the mosses and lower plants, an abridgment of the system used in Strasburger, Noll, Schenk and Karsten's "Text-Book of Botany," and other text-books, has been used. The statistics as to genera and species are taken from Engler and Prantl, and are intended as general information, and may not in all cases conform to the limitations as worked out by the different authors in the Cyclopedia. In some cases, particularly in Cactaceæ, other authorities have been followed.

As no genera of the Thallophyta or Bryophyta are definitely treated in the body of the Cyclopedia, these two groups have been introduced into the synopsis largely as a background and as a proper perspective to the plant kingdom. Therefore, in these groups no divisions smaller than classes have been considered. In the Pteridophyta and Spermatophyta, the plan has been to include in the synopsis every family that has at least one genus represented in the body of the original Cyclopedia. A few other families of minor horticultural value have found place in the present Cyclopedia and are not included in this synopsis. Although the treatment in each case has been of necessity reduced to great brevity, it is hoped that the condensed account of important structural characteristics, size of family, range, and economic value will be of aid in forming a conception of what each family represents. To render this conception more vivid, a list of the important cultivated genera and their common names has been appended to the treatment of each family.

The number of species in the plant kingdom is not definitely known. It has been estimated that more than 120,000 species of Spermatophyta and more than 60,000 species of lower plants are described. According to the treatment in Engler and Prantl, these legions are classified in 640 families, of which 278 are of the higher plants and 362 of plants below the Spermatophyta. The number of known species, however, is being rapidly increased as research and exploration progress, so that the numbers given above are at best only approximate. The figures are also modified by disagreement as to what are species and what are varieties, some persons recognizing more or fewer species than others in a given genus or group.

The names of the natural families are mostly derived from the names of a leading genus (as *Verbenaceæ*, *Ranunculaceæ*) or from some marked characteristic of the group as a whole (e.g., *Compositæ*, composite or compound flowers, *Cruciferæ*, cross-like flowers). Commonly the family name terminates in the form *aceæ*, with the accent long on the antepenultimate syllable (e.g., *Rosaceæ*, pronounced Ro-*say*-si-ee). The simple termination *æ* is used mostly for subfamilies and tribes, but there are marked exceptions, as in *Leguminosæ*.

The illustrations accompanying this text are designed to show mainly such structural characteristics as are of importance in the separation of families. For this reason, floral diagrams have been freely introduced. These

diagrams are idealized cross-sections of the flower, and show particularly the number of parts in each floral set and their exact position, both of which are very frequently of diagnostic importance. The illustrations have been prepared by F. Schuyler Mathews under the direction of the writer. They were in part drawn from life, and in part adapted from standard texts. The most frequent sources are Baillon, "Natural History of Plants"; Engler and Prantl, "Die Natürlichen Pflanzenfamilien;" Strasburger, Noll, Schenk and Karsten, "Text-Book of Botany"; Warming, "Systematic Botany."

The following is an outline of the vegetable kingdom as treated in the succeeding pages:

Division I. Thallophyta.
- Class I. Bacteria.
- II. Cyanophyceæ.
- III. Flagellata.
- IV. Myxomycetes.
- V. Peridineæ.
- VI. Conjugatæ.
- VII. Diatomeæ.
- VIII. Heterocontæ.
- IX. Chlorophyceæ.
- X. Characeæ.
- XI. Phæophyceæ.
- XII. Rhodophyceæ.
- XIII. Phycomycetes.
- XIV. Eumycetes.
- XV. Lichenes.

Division II. Bryophyta.
- Class I. Hepaticæ.
- II. Musci.

Division III. Pteridophyta.
- Class I. Filicinæ.
  - Sub-class I. Eusporangiatæ.
    - Order 1. Ophioglossales.
      - Family Ophioglossaceæ, page 7.
    - Order 2. Marattiales,
      - Family Marattiaceæ, 7.
  - Sub-class II. Leptosporangiatæ.
    - Order 3. Filicales.
      - Family Hymenophyllaceæ, 8.
      - Cyatheaceæ, 8.
      - Polypodiaceæ, 8.
      - Ceratopteridaceæ, 8.
      - Schizæaceæ, 9.
      - Gleicheniaceæ, 9.
      - Osmundaceæ, 9.
    - Order 4. Hydropteridales.
      - Family Marsileaceæ, 9.
      - Salviniaceæ, 10.
- Class II. Equisetinæ.
  - Order 5. Equisetales.
    - Family Equisetaceæ, 10.
- Class III. Lycopodinæ.
  - Order 6. Lycopodiales.
    - Family Lycopodiaceæ, 10.
  - Order 7. Selaginellales.
    - Family Selaginellaceæ, 10.

Division IV. Spermatophyta or Siphonogamia (Phanerogamia).
- Sub-division I. Gymnospermæ.
  - Order 8. Cycadales.
    - Family Cycadaceæ, 11.
  - Order 9. Ginkgoales.
    - Family Ginkgoaceæ, 11.
  - Order 10. Coniferales.
    - Family Taxaceæ, 11.
    - Pinaceæ, 12.
  - Order 11. Gnetales.
    - Family Gnetaceæ, 12.
- Sub-division II. Angiospermæ.
  - Class I. Monocotyledoneæ.
    - Order 12. Pandanales.
      - Family Typhaceæ, 13.
      - Pandanaceæ, 13.
    - Order 13. Helobiæ.
      - Family Naiadaceæ, 13.
      - Aponogetonaceæ, 13.
      - Family Alismaceæ, page 13.
      - Butomaceæ, 14.
      - Hydrocharitaceæ, 14.
    - Order 14. Glumifloræ.
      - Family Gramineæ, 14.
      - Cyperaceæ, 15.
    - Order 15. Principes.
      - Family Palmaceæ, 16.
    - Order 16. Synanthæ.
      - Family Cyclanthaceæ, 17.
    - Order 17. Spathifloræ.
      - Family Araceæ, 17.
      - Lemnaceæ, 18.
    - Order 18. Farinosæ.
      - Family Bromeliaceæ, 18.
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DIVISION I. THALLOPHYTA

Plants characterized rather indefinitely by the absence of an archegonium around the egg, and the absence of the type of antheridium found among the higher plants. The plant body is rarely differentiated into organs simulating stem and leaves, and no true vascular tissue is found in the group. Formerly the Thallophyta were divided into the Algæ, Fungi, and Lichens; but this, though a good classification on physiological grounds, does not indicate actual relationship so well as the modern division into fifteen classes founded on structure, as follows:

CLASS I. BACTERIA

Unicellular or filamentous organisms without green color, possibly "degenerated" from the Cyanophyceæ, with no true nucleus, the cell-wall often gelatinous: reproduction wholly asexual by division into two equal portions and subsequent separation (fission); or by asexual spores, one of which may be produced in each cell. Bacteria are probably the smallest known organisms, some being not over .00003 inch in diameter. In form, the cells are either oblong, spherical or spiral, and may be separate or united in groups or chains, and may be either motile by means of cilia or non-motile. Bacteria, while showing little structural diversity, have become highly specialized physiologically, and it is on this basis that the species are usually distinguished. Many cause disease among animals and human beings, while others cause disease among plants. Nitrifying bacteria in the soil are of vital importance to higher plants. Bacteria and fungi are the causes of decay.

CLASS II. CYANOPHYCEÆ (Blue-green Algæ)

Unicellular or filamentous algæ of blue-green color; true nuclei wanting: cell-wall often gelatinous: reproduction wholly asexual by fission or by asexual spores borne as in the bacteria. The blue-green algæ inhabit water, damp soil, damp rocks, or damp tree trunks, where they often form filamentous or gelatinous, dark green patches. The aquatic forms prefer water containing much organic matter and hence are abundant in sewers. Certain species inhabit flower-pots in greenhouses, and brick walls.

CLASS III. FLAGELLATA (Flagellates)

Simple unicellular aquatic organisms intermediate between the Thallophyta and Protozoa. During a portion of their life they possess no cell-wall, and often show amœboid movements. The cells contain a nucleus, pulsating vacuole, and chlorophyll; and one or more cilia are present. Some reduced forms are colorless and saprophytic. Reproduction is wholly asexual by fission and thick-walled resting spores. Found in waters of ponds and streams.

CLASS IV. MYXOMYCETES (Slime Molds)

A very distinct and independent group, formerly often classified in the animal kindgom. The plants consist of naked masses of protoplasm called plasmodia, which contain many nuclei but no chlorophyll. These are found in forests and damp, shady places. When ready to fruit, the plasmodia move toward the light and away from the water, hence ascend grass stems, stumps and logs, where they transform into elaborately constructed sporangia. The asexual spores, each enclosed by a cell-wall, are distributed by the wind, germinate, produce a ciliated bit of naked protoplasm which swims in the soil moisture, multiply by division and at length fuse with neighboring protoplasts to form the plasmodium, which latter may be sometimes a foot in breadth. During unfavorable weather, the plasmodia are often transformed into sclerotia. *Plasmodiophora brassicæ*, which is the cause of the club-root of cabbage, is the only Myxomycete of great economic importance.

CLASS V. PERIDINEÆ

A small group mostly inhabiting the sea, more rarely fresh water. They are unicellular, free-swimming organisms with nucleus, vacuole, chromatophores, and cilia. The cell is usually surrounded by a cellulose, sculptured, or pitted and transversely furrowed, wall. Reproduction is by cell-division and swarm-spores Sexual reproduction has recently been discovered. The Peridineæ often form an important part of the plankton in the sea.

CLASS VI. CONJUGATÆ

Green filamentous or unicellular fresh-water algæ: cell-wall and nuclei present: reproduction by division of the plant body, and by sexual spores, which latter result from the union of two body cells by means of a connecting tube (conjugation). Plants of the sub-group Desmidiaceæ are not filamentous, but often star-shaped, lunate, or geminate in outline. The Zygnemaceæ are filamentous with star-shaped (Zygnema), spiral (Spirogyra), or plate-like chloroplastids. The Conjugatæ are of little economic importance.

CLASS VII. DIATOMEÆ (Diatoms)

Unicellular algæ of very peculiar and interesting habit. The wall consists of two silicious valves, one of which fits over the other like the lid of a box. These valves are frequently very beautifully sculptured. Through division, new cells and new walls are formed, which are always smaller than before, until finally as a limit a sexual spore is produced which reëstablishes the size of the cell. Diatoms inhabit stagnant water, wet rocks, and the sea. They are either free-floating or pedicelled and attached. The silicious walls will resist burning. Diatoms contain little, if any, chlorophyll, and are mostly saprophytic. A large part of the oceanic plankton is composed of Diatoms.

CLASS VIII. HETEROCONTÆ, or CONFERVÆ

A small group of green algæ, inhabiting wet soil or water, but of little, if any, economic importance. The zoöspores have unequal cilia; and the chloroplastids are yellowish green and oil-producing. Asexual resting spores also occur. Conjugating zoöspore-like gametes are found in some genera. Botrydium and Conferva are examples of this class.

CLASS IX. CHLOROPHYCEÆ

A large and important group of fresh-water, or rarely marine, algæ. Plant body unicellular, filamentous, or even thalloid: the cells contain chloroplastids and produce starch: reproduction sometimes vegetative, but also by asexual zoöspores; sexual reproduction con-

sists of the the fusion of two zoöspore-like gametes, or the fusion of one such gamete and a specialized non-motile egg. The latter condition is characteristic of the higher forms in nearly all the sub-groups of the Chlorophyceæ. The plant body in the Order Siphonales is peculiar in that it consists of a continuous tube without cross-walls. Some common genera in this class are Volvox, Chlamydomonas, Pandorina, Protococcus, Pediastrum, Scenedesmus, Hydrodictyon (Water-net), Ulothrix, Ulva (Sea-lettuce), Œdogonium, Cladophora, Caulerpa, and Vaucheria.

CLASS X. CHARACEÆ (Stoneworts)

Attached plants (1 inch to 1 yard in length) of fresh or brackish water, consisting of a slender stem, which bears at each node a whorl of branches, usually again bearing whorled branchlets. The internodes consist of one immense multinucleated cell often as much as 3 inches long, which is naked or inclosed in a sheath of smaller cells. The branches are similarly constructed though the cells are correspondingly smaller. Asexual spore-reproduction is absent. Sexual reproduction is by means of an egg-cell inclosed in a jacket of spiral wall-cells, and of sperm-cells inclosed in an antheridium which has a multicellular wall. These sexual organs are borne at the nodes of the branchlets. The fertilized egg and its investment becomes a thick-walled resting structure. Many species of Chara and Nitella, the only two genera, have the power to deposit lime from solution, and thus become incrusted with that substance, hence the popular name. In this way the Characeæ have played a part in the filling up of calcareous lakes and the production of new land. They are mostly inhabitants of calcareous waters.

CLASS XI. PHÆOPHYCEÆ (Brown Seaweeds)

A large group of salt-water algæ, well known in all waters of the globe, but most abundant in the colder regions. Plant body attached, usually thalloid and branched, but very diverse; in some cases filamentous, in others disk-shaped or globular. The larger forms of Laminaria are sometimes 200 feet long. The chromatophores of the Phæophyceæ contain a brown pigment which gives to these plants a brown or yellowish color instead of green. The thallus is often very tough and cartilaginous, to resist the waves. Zoöspores are often produced. In sexual reproduction, the gametes are either similar and motile, rarely non-motile, or more often the sperm is motile while the egg is much larger and non-motile. Details of structure in respect to reproduction, however, are very great.

The thallus of various species of Phæophyceæ yields iodine and soda. Some species (e.g., *Laminaria saccharina*) yield mannite and are used in the Orient for food. The dried stalks of *L. digitata* and *L. Cloustoni* have been used in surgery. Fucus and other genera are used as manure.

One species, *Sargassum bacciferum*, has accumulated in great quantities in the Atlantic Ocean between the Bermuda Islands and the Spanish coast, in the so-called "Sargasso Sea."

CLASS XII. RHODOPHYCEÆ (Red Seaweeds)

Mostly marine algæ, a few only inhabiting fresh water, widely distributed, but most abundant in the tropics and temperate region at lower depths. The thallus is very diverse, filamentous, branched, often thalloid, attached by holdfasts, and red, violet, or purple in color, rarely green. True starch is not found. Asexual spore-reproduction is frequent. These spores are non-motile and produced in fours (tetraspores). Sexual reproduction is by dissimilar gametes, the antheridium becoming without change a single non-motile sperm-cell. The egg-cell is prolonged upward into a slender tube (trichogyne). The fertilized egg by division gives rise to a globular mass of short filaments (cystocarp) which produce asexual spores. These spores in turn give rise to the mature plant. The cystocarp and its spores, thus following fertilization, suggest the alternation of generations found in the mosses and liverworts and all higher plants. About 300 species of Rhodophyceæ have been described.

Carragheen, or Irish moss, used in jellies and puddings, is the dried thallus of *Chondrus crispus* and *Gigartina mamillosa* of northwestern Europe. Agar-agar, used in the preparation of culture media in bacteriology and mycology, is obtained from various species of this group.

CLASS XIII. PHYCOMYCETES

A large group of parasitic or saprophytic organisms (fungi), without chlorophyll: thallus (mycelium) of much-branched filaments (hyphæ); usually without cross-walls (non-septate), as in the algal group Siphoneæ: asexual reproduction by motile or non-motile spores which are usually borne in sporangia, and by conidia which are cells abstricted from the tips of specialized hyphæ: sexual reproduction diverse, either by the conjugation of similar gametes, or by the conjugation of a specialized antheridial branch (male) and an enlarged oögonial branch (female) which contains the egg; free sperm-cells are rare. The order **Oömycetes,** with differentiated gametes, contains the following important fungi: Saprolegnia (water-mold), a whitish, aquatic mold growing on decaying plants, insects, or living fishes; *Olpidium brassicæ*, parasitic in cells at the base of the stem of young cabbage plants causing their death; *Phytophthora infestans* (potato disease); *Plasmopara viticola*, downy or false mildew of the grape; *Albugo candida*, white rust of Cruciferæ; *Pythium de Baryanum*, causing damping off of seedlings. Order **Zygomycetes,** with similar gametes, contains *Mucor mucedo*, white mold of bread, fruits, etc.; *Rhizopus nigricans*, a mold on bread, fruit, etc.; *Empusa muscæ*, parasitic on houseflies, causing their death and producing a white halo about them on the surface where they die.

CLASS XIV. EUMYCETES

A very large and important group of saprophytic or parasitic organisms (fungi) without chlorophyll: thallus (mycelium) composed of fine tubular threads, which are septate: sexual organs usually obscure or apparently wanting: asexual reproduction by spores or by conidia, a modified form of which is termed basidia. The conidia and basidia do not always represent homologous organs. The group is divided into Ascomycetes and Basidiomycetes. The Ascomycetes are characterized by a group of usually 8 spores inclosed in a unicellular sac (ascus), which is produced immediately after the imperfect sexual fertilization. The asci are borne in spherical bodies (perithecia) or in open cups (apothecia). The Perisporiaceæ, Discomycetes, Pyrenomycetes, and Tuberaceæ are orders within this sub-class. Among the many important economic fungi belonging here are the following: Erysipheæ (Downy Mildews); Aspergillus and Penicillium (Fruit Mold, Blue Mold); Morchella (Morel), edible; Nectria (Currant Cane Rust and Tree Canker); *Claviceps purpurea* (Ergot), parastic in the ovaries of grains; Taphrina (including Exoascus), causing witches' broom, leaf curl of peach, plum pockets, etc.; Saccharomyces (Yeast), causing fermentation in saccharine solutions. The Basidiomycetes are characterized by the production of four spores on a special hyphal tip or thread (basidium). Each spore is raised on a minute slender stalk (sterigma). These spores, in some cases, if not in all, follow immediately after a nuclear fusion, which probably represents a reduced sexual act. In this group are the Ustilagineæ (Smuts), infesting the ovaries of grains, etc.; the Uredineæ (Rusts), which infest a wide variety of cultivated and wild plants, and among which may be men-

tioned the wheat rust; the Hymenomycetes (Mushrooms, Toadstools, and Bracket Fungi), which are saprophytic or inhabit timber; and the Gasteromycetes (Puff-balls), which are saprophytic. The rusts exhibit alternation of generations to a most remarkable degree, the different generations often inhabiting different host plants and possessing a wholly different appearance, as well as a wholly different method of spore-formation. The Hymenomycetes are saprophytic, except the genus Exobasidium which inhabits the living foliage of various plants, the genus Armillaria which infests living tree-trunks, and many genera of the Polyporaceæ (Bracket Fungi) which also attack the wood of living trees. The last-mentioned fungi, including Armillaria, inhabit the trunks and branches of forest trees, causing their death.

CLASS XV. LICHENES (Lichens)

Green, gray or highly colored plants of very diverse habit and habitat, either thalloid, fruticose or crustaceous, and growing on the soil, bark of trees, rocks, or rarely on foliage: propagation by division of the thallus or by the separation of special minute powdery parts (soredia): spore-reproduction by ascospores borne in perithecia or apothecia, rarely by basidiospores. The lichen thallus is not a single organism, but is probably a symbiotic structure, comprised fundamentally of fungus hyphæ between which many unicellular green algæ are distributed, usually in a definite fashion. The fungi belong to the Ascomycetes in the great majority of cases, rarely to the Basidiomycetes. The algæ may belong to the Chlorophyceæ, in which case they are unicellular, or to the Cyanophyceæ, in which case they are either unicellular or in chains. Because the symbiotic structure behaves as a unit, it has been decided to continue to treat the lichens as a class by themselves, rather than to consider the algal and fungal components independently in their respective groups. Except as soil-producers, lichens are of little economic importance: *Cetraria islandica* furnishes Iceland moss; *Sticta pulmonaria* was once used in medicine; *Cladonia rangiferina* furnishes the main food of the reindeer in Lapland, and, possibly, of other arctic animals; *Roccella tinctoria* of Africa and the East Indies is the source of the chemical indicator, litmus and of the dye orchil or orseille.

DIVISION II. BRYOPHYTA
(Mosses and Liverworts)

Small green plants of simple structure, either thalloid or differentiated into stem and leaves: true roots wanting: vascular tissue absent: alternation of generations well developed, the gamete-bearing generation dominant: female gamete (egg) inclosed in a flask-shaped multicellular archegonium: male gametes (sperm-cells) inclosed within a multicellular antheridial wall: fertilized egg producing the spore-bearing generation (sporogonium) which consists of a parasitic or semi-parasitic capsule usually borne upon a seta.

The Bryophytes are divided into two great classes, namely the Hepaticæ (Liverworts) and the Musci (Mosses). Each of these in turn is divided into several orders, which, as usual, contain one or more families. Mosses and liverworts are widely distributed over the earth, the latter seeming to prefer limestone regions.

The Hepaticæ are characterized by a spore-bearing generation consisting of a stalked or sessile simple capsule, which contains spores and elongated sterile elaters, and splits into teeth or valves at maturity. The plant body (gamete-bearing generation) consists either of a thalloid, algal-like, dichotomously branching, ribbon-like structure, or of a slender axis bearing the very thin leaves, one cell in thickness, and destitute of a midrib. The leaves are usually arranged in two lateral rows, with often a third row of small dissimilar leaves on the under side, so that the shoot is strongly dorsi-ventral. The lateral leaves frequently bear at the base a curious lobe that is infolded or even flask-shaped, and probably aids in the conservation of water on the dry rocks and tree trunks which many of these plants frequent. The under side of the stem or thallus is usually provided with rhizoids that take the place of roots. The thalloid liverworts are inhabitants of damp or wet situations, some being aquatic: in the North, they are found on damp soil, wet rocks, or among damp moss. The majority of foliose liverworts inhabit similar places, only comparatively few genera and species being xerophytic. Filaments of the alga, Nostoc, penetrate the cavities in the thallus of Anthoceros and there form endophytic colonies. Vegetative reproduction is accomplished by the branching of the thallus, or by the production of special buds, called gemmæ, either on the edge of the leaf or thallus, or in special cup-like receptacles borne on the surface of the thallus.

The Hepaticæ are divided into four principal orders as follows: Order I.—**Ricciales.** Thalloid, floating or amphibious: sexual organs sunken in the thallus: capsule sessile, thin-walled, endophytic, irregularly dehiscent. Order II.—**Marchantiales.** Thalloid: archegonia and antheridia usually borne on special branches of the thallus: capsule often stalked, usually regularly dehiscent. Marchantia was formerly used as a remedy in diseases of the liver, hence the name liverwort. Order III.—**Anthocerotales.** Thalloid: one chloroplast in each cell: sexual organs superficial: capsule very slender, chlorophyll- and stomate-bearing, continuing to elongate by basal growth. Order IV.—**Jungermanniales.** Thalloid or foliose: capsule usually splitting to the base into four valves.

The Musci (Mosses) differ from the Hepaticæ mainly in the more elaborate capsule, which in the young state commonly contains chlorophyll, is provided with stomates, and contains a central column of sterile tissue (columella) encircled by the spore-bearing chamber. The dehiscence of the capsule is apical and transverse, and consists in the formation of a lid (operculum) which falls off exposing the mouth of the annular spore-chamber. This mouth is surrounded by a single or double row of numerous hygroscopic teeth (peristome), which, by their bending, regulate the escape of spores in wet and dry weather. No elaters are produced. The sporogonium of the moss is, therefore, not only a more independent structure from the standpoint of nutrition than is that of most liverworts, but is constructed along wholly different lines. On the summit of the capsule is usually found a delicate, diversely shaped, hood-like cap not organically connected with it and easily detached, called the calyptra. This is the enlarged upper portion of the archegonium, which, after rupture, is borne aloft on the summit of the growing sporogonium. The plant-body (gamete-bearing generation) is never thalloid; and the leaves, which are provided with a midrib, are frequently of several cells in thickness. The germination of the spore does not result at once in a moss plant, but produces a creeping filamentous branched, algal-like growth (protonema) on which at length are borne the buds that give rise to the moss-stem proper.

The Musci are subdivided as follows: Order I.—**Sphagnales** (Bog or Peat Mosses). Structure of stem and leaf peculiar, consisting of dead, tracheid-like cells without protoplasm and provided with pits or thickening bands, regularly interspersed among slender, living cells containing protoplasm and chloroplastids. Under ordinary conditions, the tracheid-like cells are filled in part with air, and hence the plant has a grayish hue. In the presence of rain or abundant soil-water, the water is drawn into the cells by capillarity until the still apparently dry plant contains a surprisingly large quantity of water, which will flow out on squeezing

in the hand. The capsule possesses no peristome, and the spore-sac is continuous over the top of the columella. Peat mosses are large, branched plants growing in extensive colonies in wet or damp situations in northern countries. They are especially abundant on the floating moors which surround certain small ponds, and by their decay play an important part in the filling in of these ponds. They continue to thrive in these "bogs" until the conditions at length become too dry. Peat mosses, therefore, form a large component of "peat," and in this way the Sphagnales have played a very interesting part in the evolution of the present surface of the earth. Because of the power to retain water, sphagnum is of economic importance to nurserymen and florists, who use this moss extensively in packing stock for shipment, in germinating seeds, and for other purposes. Some species of sphagnum are eaten in Lapland by the reindeer. Mixed with the hair of the reindeer, they are used for stuffing mattresses. Order II.—**Andreales.** A small group of rock mosses. The spore-chamber is continuous over the summit of the columella, and the capsule dehisces by four longitudinal slits. Order III.—**Phascales.** A small group of minute terrestrial mosses with few leaves, but a persistent protonema: capsule indehiscent, at length decaying. Order IV.—**Bryales.** A large group containing the majority of the mosses: capsule dehiscing by an operculum; peristome present; spore-sac interrupted at the summit by the columella. Certain species were formerly used as astringents and diuretics. *Leskea sericea* has been used to stop the flow of blood from wounds. Species of Hypnum and Fontenalis are used in Norway and Sweden, by the peasants, to fill cracks in the walls of huts. *Hypnum triquetrum* is sometimes used in place of sphagnum for packing plants.

With the exception of sphagnum, the mosses and liverworts do not seem to be in the trade.

DIVISION III. PTERIDOPHYTA

Eggs borne in archegonia: sperm-cells in antheridia: alternation of generations clearly evident, the spore-bearing generation dominant: true vascular tissue present; also true roots.

CLASS I. FILICINÆ (Ferns)

Sub-class I. Eusporangiatæ. Sporangial wall several cells in thickness

Order 1. OPHIOGLOSSALES

1. **Ophioglossaceæ** (from the genus *Ophioglossum, adder's tongue,* in reference to the fruiting spike). ADDER'S-TONGUE FAMILY. Fig. 1. Plants small or of medium size, often somewhat fleshy: leaves various, entire or often much divided, not circinate in vernation; veins forking or netted; base of leaf cap-like, enclosing the succeeding leaf: sporangia scattered, borne on the margin of the much modified fertile portion of the leaf, which is usually separated from the sterile by a stalk, globular in form; the walls several cells in thickness; annulus wanting; dehiscence by a straight horizontal or vertical fissure: prothallium subterranean, tuber-like, chlorophylless, containing mycorrhizal fungi, saprophytic.

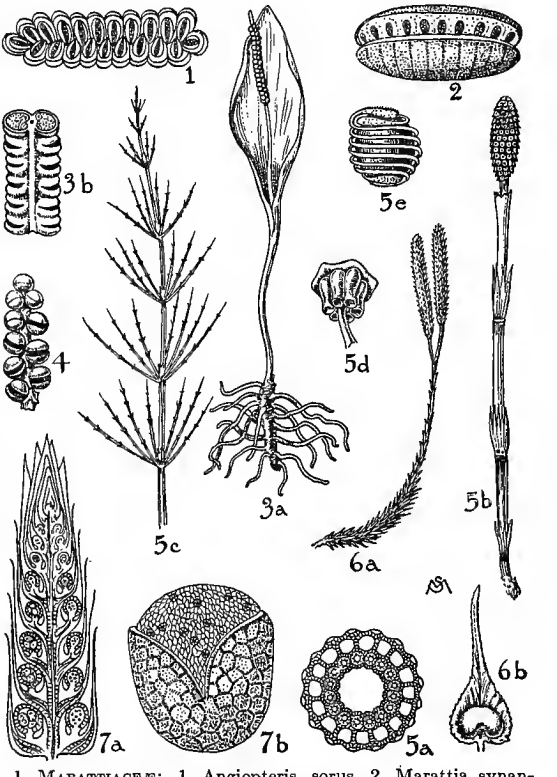
Three genera and about 50 species occur, of general distribution. Several species of Botrychium and one of Ophioglossum are found in the eastern United States. The sheathing base of the leaf, the solitary, thick-walled sporangia without an annulus, and the subterranean saprophytic prothallia are important characteristics.

Two genera are sometimes grown in North America: Botrychium (Moonwort Ferns, Grape Ferns) and Ophioglossum (Adder's Tongue).

Order 2. MARATTIALES

2. **Marattiaceæ** (from the genus *Marattia,* named in honor of Maratti, Italian botanist). MARATTIA FAMILY. Fig. 1. Stately tropical ferns with thickened, often erect, stems: leaves usually very large, from nearly entire to several times pinnate, circinate, inclosed when young by the prominent stipules: indusium present or absent: sporangia in sori on the under face of the leaf, either separate or united into a capsule-like body (synangium); the walls several cells in thickness; annulus wanting, or greatly reduced; dehiscence by clefts, pores, or, in case of the "synangia," first by valves and then by slits: prothallium a green heart-shaped thallus on the surface of the soil, sometimes branched.

Four genera and about 23 species are found in tropical regions, but extend into the south temperate



1. MARATTIACEÆ: 1. Angiopteris, sorus. 2. Marattia, synangium. OPHIOGLOSSACEÆ: 3. Ophioglossum, *a*, whole plant; *b*, dehiscing sporangia. 4. Botrychium, sporangia. EQUISETACEÆ: 5. Equisetum, *a*, cross-section stem; *b*, fruit stem; *c*, sterile stem; *d*, sporophyll and sporangia; *e*, spore and elater. LYCOPODIACEÆ: 6. Lycopodium, *a*, fruit branch; *b*, sporophyll and sporangium. SELAGINELLACEÆ: 7. Selanginella, *a*, fruit spike; *b*, spore showing prothallium and archegonia.

zone. The fern-like habit, the prominent stipules, the thick-walled sporangia borne in sori or synangia, the absence of a well-developed annulus, and the green thalloid emersed prothallia, are important characteristics. The family is probably very old geologically.

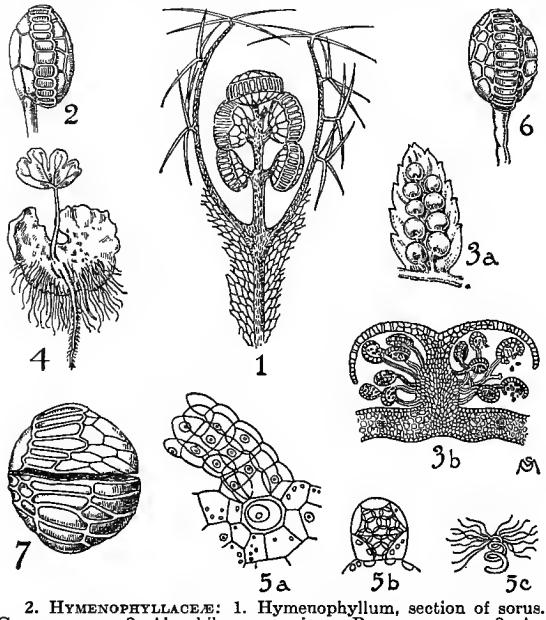
The thick, starchy stem of Angiopteris and some Marattias are locally used for food. The fleshy stipules of *Marattia fraxinea* are eaten; the spicy leaves of some species are used to season food. The slime from the stipules of *M. Douglasii* is used medicinally by the Hawaiians.

Three genera are known to American horticulture and are occasionally grown as ornamental greenhouse plants: Angiopteris, Danæa, and Marattia, representing less than a half-dozen cultivated species.

Sub-class II. Leptosporangiatæ. Sporangial wall one cell in thickness

Order 3. FILICALES

3. **Hymenophyllaceæ** (from the genus *Hymenophyllum*, signifying *membrane-leaved*). FILMY-FERN FAMILY. Fig. 2. Very delicate ferns, small or minute in size, frequently epiphytic: leaves entire, 1–3-pinnate, or dichotomously divided, rarely thalloid or orbicular, reduced in thickness to a single layer of cells between the veins, and thus often resembling the leaves of mosses; stomates absent; ultimate or all veins dichotomous: sori marginal, raised on a slender columnar pro-



2. HYMENOPHYLLACEÆ: 1. Hymenophyllum, section of sorus. CYATHEACEÆ: 2. Alsophila, sporangium. POLYPODIACEÆ: 3. Aspidium, *a*, pinnule with sori; *b*, section of sorus. 4. Adiantum, prothallium with young fern plant. 5. Polypodium, *a*, archegonium; *b*, antheridium; *c*, sperm. 6. Peranema, sporangium. GLEICHENIACEÆ: 7. Gleichenia, sporangium.

jection of the veinlet: indusium cup-shaped: sporangium thin-walled; dehiscence vertical or oblique; annulus complete, horizontal: prothallium thalloid or filamentous, often much branched.

There are 2 genera and about 200 species growing upon rocks and trees in the damp, shady forests of the tropics, and in New Zealand. One species reaches central Europe and another reaches Kentucky. The family is readily distinguished by the delicate leaf, pedicelled sorus and equatorial annulus.

The Hymenophyllaceæ require a warm and very humid atmosphere, and, therefore, most species are difficult to cultivate.

Several species of Hymenophyllum and Trichomanes are in cultivation in America.

4. **Cyatheaceæ** (from the genus *Cyathea*, signifying *cup+contain*, in reference to the cup-shaped indusium). CYATHEA FAMILY. Fig. 2. Usually tree ferns with large, much-compounded, circinate leaves: sori globular, borne on the under side of the leaf: veins forking: indusium usually present, bi-valvular, cupular or unilateral: sporangia thin-walled, sessile or short-pedicelled, obovoid; annulus complete at the pedicel, oblique, dehiscence transverse: prothallium ordinary, green.

This family has 7 genera and about 300 species, of which 115 belong to Cyathea, 112 to Alsophila, and 44 to Hemitelia. They are distributed in the tropics of both hemispheres. The Cyatheaceæ is closely related to the Polypodiaceæ from which it differs only in the slightly oblique annulus which passes just at one side of the insertion of the pedicel, and is therefore uninterrupted at that point.

The dense, woolly covering of the stem of many species is sometimes collected for stuffing pillows. The starchy pith of some New Zealand Cyatheaceæ was formerly used for food. In India, an intoxicating drink is prepared from the pith. Several species are important greenhouse ferns.

Five genera at least are listed in the American trade: Alsophila, Cibotium (Scythian Lamb), Cyathea, Dicksonia, Hemitelia.

5. **Polypodiaceæ** (from the genus *Polypodium*, signifying *many feet*, in allusion to the branched rootstock of some species). POLYPODY FAMILY. Fig. 2. Ferns of very diverse habit, rarely arborescent: leaves of normal texture, entire or pinnatifid or multisect, circinate; veins forking: sori mostly on the under side of the leaf; indusium peltate, fringed, capillary, cupular, elongated, unilateral or wanting: sporangia thin-walled, long- or short-stalked; annulus vertical, interrupted by the pedicel; dehiscence transverse: prothallium thalloid, green, growing upon the surface of the soil, mostly bisexual.

Polypodiaceæ has more than 100 genera and about 4,000 species of wide distribution; especially abundant in humid regions and in forests. The largest genera are: Dryopteris (or Aspidium), 450 species; Polypodium, 500 sp.; Asplenium, 150–200 sp.; Elaphoglossum, 80–100 sp.; Adiantum, 80 sp.; and Pteris, Blechnum, Polystichum and Aspidium about 50–70 species each. The family is most closely related to the Cyatheaceæ. The presence of sori, the thin-walled sporangium with vertical interrupted annulus and transverse dehiscence are distinctive. This comprises the larger number of ferns, and is often called the Fern Family.

Some of the most striking variants are the walking-leaf fern with undivided lanceolate leaves which take root at the apex and repeat the process several times, all the plantlets remaining for a time connected; the hart's-tongue fern with broadly lanceolate-oblong, entire frond; the epiphytic staghorn fern with erect, forked, fertile fronds and orbicular entire, sterile fronds closely imbricated over the short stem and support. In many species the fertile and sterile fronds are dimorphic. The stems of some species are slender and climbing; others long, slender and creeping; some are very stout and erect (tree ferns).

The ferns are of little economic importance except as ornamental plants. The starchy rootstocks of some species are eaten locally, as are also the young shoots. The rootstock of *Dryopteris* (*Aspidium*) *Filix-mas* is a reputed vermifuge.

About 60 species are in cultivation in America. Among these are: Adiantum (Maidenhair Fern); Aspidium (Shield F.); Asplenium (Spleenwort); Camptosorus (Walking-leaf F.); Dennstædtia (Dicksonia) (Fragrant F.); Onoclea (Sensitive F., Ostrich F.); Pellæa (Cliff Brake); Phegopteris (Beech F.); Platycerium (Staghorn F.); Polypodium (Polypody F.); Polystichum (Holly F., Christmas F.); Pteris (Common Brake); Scolopendrium (Hart's-tongue F.).

6. **Ceratopteridaceæ** (Parkeriaceæ) (from the genus *Ceratopteris*, meaning *horn-fern*). CERATOPTERIS FAMILY. Aquatic ferns rooting in the mud: leaves of two sorts, the ones less divided with broader segments and veins more or less anastomosing; the more aërial fertile ones much divided, with narrow segments, and revolute margins which later almost completely inclose the scattered sporangia: indusium wanting: sporangia globular, thin-walled with a very diverse broad nearly complete or nearly wanting annulus; rarely the annulus wanting; dehiscence transverse: prothallia unisexual, thalloid; antheridia not superficial.

Only one genus and a few species of tropical distribution are known, the only aquatic species among the true ferns. The habit, the absence of sori, the variable annulus, and the sunken antheridia are distinctive.

This fern is sometimes cooked and eaten as greens.

One or two species are frequently grown for aquaria and aquatic gardens.

7. **Schizæaceæ** (from the genus *Schizæa, cleft,* alluding to the leaves). CURLY-GRASS FAMILY. Fig. 3. Ferns of very diverse habit, some extremely small, others climbing: stem mostly oblique or horizontal: leaves very diverse, usually pinnate or palmate; veins forking: sporangia thin-walled, usually scattered, at first marginal, later sometimes exceeded by the margin of the frond, often appearing spiked or panicled, sessile; no apparent indusium; annulus transverse, apical, complete; dehiscence vertical; fertile portion of the frond usually much modified: prothallium of all genera except Schizæa ordinary; that of the latter genus filamentous and extremely branched, resembling that of the filmy ferns.

In this family are 4 genera and about 70 species, mostly tropical, rare in the colder regions. Two species reach the eastern United States, one of which extends to Newfoundland. The solitary sporangia and transverse apical annulus are important characteristics.

The curly grass (*Schizæa pusilla*) inhabits bogs, where it may form extended mats of dry, woolly "grass" 1–3 inches high. The sterile leaves are without laminæ. *Lygodium palmatum* is the "climbing fern" of eastern America. The leaf, not the stem, of this plant has unlimited growth, and twines.

Four genera are in the American trade: Anemia. Lygodium, Mohria, and Schizæa.

8. **Gleicheniaceæ** (from the genus *Gleichenia,* named in honor of W. F. Von Gleichen, 1717–1783). GLEICHENIA FAMILY. Fig. 2. Terrestrial ferns with peculiar foliage: leaves several times forking owing to the arrested growth of the main divisions which develop in succeeding seasons, only the ultimate branches pinnate (except in one genus): indusium none: sporangia in sori on the under side of the leaf, thin-walled, sessile, pear-shaped; annulus complete, running obliquely around the back and over the top; line of dehiscence extending vertically down the ventral side from a constricted apical place in the annulus: prothallium ordinary, green.

Two genera and about 26 species occur in tropical lands and the south temperate zone. The family is related to the Schizæaceæ but the habit is very different. The peculiar forking of the leaves, as well as the unusual annulus and peculiar dehiscence, are characteristic.

A few species of Gleichenia are in cultivation in North America.

9. **Osmundaceæ** (from the genus *Osmunda,* derived from *Osmunder,* the Saxon name of the god Thor). OSMUNDA FAMILY. Fig. 3. Ferns of ordinary habit, rarely aborescent: rhizome mostly vertical, thick: leaves large, circinate, 1–3-pinnate, rarely thin and stomateless; petiole somewhat sheathing at the base; fibrovascular bundle 1; veins forking: indusia wanting: sporangia scattered on the under side of the ordinary leaf, or on the margin or on both sides of modified fertile portions of the leaf, thin-walled, short-stout-pedicelled, globular; annulus imperfect, consisting of a group of cells on one side; line of dehiscence vertical, extending from this group up over the summit: prothallium ordinary, green.

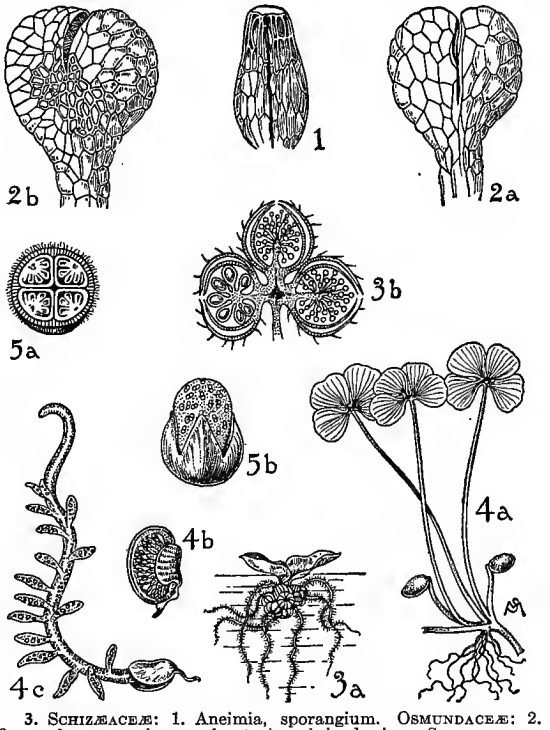
There are 3 genera and 10 or 12 species of general distribution, and others in the Australian region. Three species occur in the eastern United States. The family is related to the Gleicheniaceæ and Schizæaceæ. The peculiar dehiscence, and the scattered sporangia with the annulus consisting of a group of cells, instead of a ring, are distinctive.

The family has practically no economic importance, except as ornamental plants, except that the root masses are used as matrix on which to grow orchids and other epiphytic plants (see *Osmundine*). Some have been used in medicine, although their virtues are questionable. The family contains some of our most stately native ferns.

All three genera are in American horticulture: Leptopteris (leaves thin and no stomates); Osmunda (Royal Fern, Cinnamon Fern), Todea (Grape Fern).

Order 4. HYDROPTERIDALES

10. **Marsileaceæ** (from the genus *Marsilea,* in honor of Giavanni Marsigli, or Aloysius Marsili, Italian naturalists.) MARSILEA FAMILY. Fig. 3. Perennial marsh or aquatic plants with filiform and creeping rhizomes: leaves all from rootstocks, circinate; rachis without blade or with four leaflets borne together at the apex; leaflets, when present, fan-shaped, rounded at apex; veins dichotomous: sporangia of two sorts, macrosporangia bearing macrospores which give rise to egg-cells, and microsporangia bearing microspores which give rise to sperm-cells, both borne together in tiny chambers (sori) in globular capsule-like conceptacles (sporocarps) which arise from the rootstock or lower portion of the leaf, and are either stalked or sessile:



3. SCHIZÆACEÆ: 1. Aneimia, sporangium. OSMUNDACEÆ: 2. Osmunda, sporangium; *a*, front view; *b*, back view. SALVINIACEÆ: 3. Salvinia, *a*, whole plant; *b*, section of sporocarps showing sporangia. MARSILEACEÆ: 4. Marsilea, *a*, whole plant; *b*, sporocarp germinating; *c*, sporocarp emitting gelatinous thread with sori. 5. Pilularia, *a*, cross-section of sporocarp; *b*, sporocarp emitting sporangia.

male and female prothallia very much reduced, remaining inclosed within the spore-wall, which in the case of the macrospores early becomes ruptured on one side to expose the archegonia.

Two genera (Marsilea and Pilularia) and about 60 species occur, of which 52 or 54 belong to Marsilea. The distribution is general, though mainly tropical. Marsilea is represented in the United States by one native and one introduced species. The family is closely related to the Salviniaceæ, but the peculiar habit and unusual sporocarps are distinctive.

At maturity, a gelatinous mass escapes from the sporocarp, and on this mass the sori are borne in somewhat characteristic fashion in different species. The leaflets of the clover-like leaves of Marsilea, in emersed forms, show sleep movement, as do those of clover. These leaflets float upon the water, to the varying depths of which the petioles accommodate themselves; but the plant may grow emersed on mud, in which case the petioles are erect like clover. The leaves of Pilularia are filiform, pointed, and destitute of blade.

In Australia, the sporocarps of *Marsilea Nardu* and *M. Drummondii*, which contain much starch and other nutritious material, are used by the natives for food. They are ground into a powder, mixed with water and baked. Fish and marsilea "fruits" form almost the sole food of some tribes.

One species, *Marsilea quadrifolia*, is in cultivation in America for aquatic gardens.

11. Salviniaceæ (from the genus *Salvinia* in honor of A. M. Salvini, Italian scientist). SALVINIA FAMILY. Fig. 3. Small, floating aquatic plants, resembling large Lemnas (Salvinia) or foliaceous liverworts (Azolla): stem reduced or wanting: leaves few, orbicular or oval (Salvinia); or numerous, minute and imbricated (Azolla): sporangia and spores of two sorts as in Marsilea, but borne on basal columns in the single cavity of the sporocarp; at first both sorts of sporangia are present but only one kind matures so that the sporocarp becomes entirely "male" or entirely "female:" prothallium partly endosporous, only a portion of either the male or female prothallium emerging from the spore wall.

The family has 2 genera and about 15 species, of which 11 belong to Salvinia; generally distributed but principally tropical. Each genus is represented in the eastern United States by one native species. The family is related to the Marsileaceæ, but the habit, the structure of the sporocarps, and the separation of macrosporangia and microsporangia in different sporocarps are distinctive.

The "roots" of Salvinia represent a modified leaf. Each leaf of Azolla is two-lobed, one lobe floating, the other submerged. A small cavity inclosed by the upper lobe is always inhabited by a nostoc-like alga, between which and the Azolla there is indication of a symbiotic relationship. Azolla possesses true roots.

The family is of almost no economic importance.

One species of Salvinia and two species of Azolla are occasionally grown in water-gardens.

CLASS II. EQUISETINÆ

Order 5. EQUISETALES

12. **Equisetaceæ** (from the genus *Equisetum*, meaning *horse-bristle*). HORSE-TAIL FAMILY. Fig. 1. Plants of striking appearance, often with rhizomes and with a straight, aërial, striated axis bearing whorls of connate, scale-like leaves at the nodes: from the nodes also frequently arise slender branches of different structure which bear different but still scale-like leaves: the stem is hollow, and besides the central canal often contains numerous additional large canals imbedded in the outer tissue: spores of one kind (not microspores and macrospores): sporangia 5–9, borne on the under surface of peltate, polygonal scales which form a terminal cone; dehiscence longitudinal; spores green, provided with several hygroscopic "elaters" which aid in dissemination: prothallia green, unisexual, the female largest, branched.

A single genus and about 24 species are known, of which one section is tropical, the other of temperate distribution. Ten species are native in the eastern United States. The family is very distinct and shows no definite relationship to any existing plants. The habit, the undifferentiated spores, the peltate sporophylls, and the dicœcious emergent prothallia are distinctive. The arrangement of the canals and also of the stomates along the stem are important in the distinction of species.

The stems of *E. hiemale*, rich in silica, were formerly much used for scouring and for polishing woods, and are still used to some extent. *E. arvense* and *E. sylvaticum* have been used for polishing tin vessels, hence the name "tinweed." Several species have been used in medicine, as diuretics. *E. giganteum* is employed as an astringent. *E. arvense* and *E. palustre* are bad weeds in parts of Europe.

Several species have been advertised by American dealers in native plants.

CLASS III. LYCOPODINÆ

Order 6. LYCOPODIALES

13. **Lycopodiaceæ** (from the genus *Lycopodium*, *wolf-foot*, from a fancied resemblance). CLUB-MOSS FAMILY. Fig. 1. Branched plants of moderate size, stems often erect when short, usually prostrate, pendent, or creeping: leaves very numerous, small, subulate or oblong, moss-like, often imbricated; rarely the leaves all basal (Phylloglossum): sporophylls either similar to the leaves, or much modified and forming terminal "cones:" sporangia and spores of one sort (not macrospores and microspores), the former reniform, borne at the base of a leaf on the upper side; dehiscence longitudinal: prothallia more or less cylindrical or amorphous, in some species green, in others colorless, saprophytic, subterranean or subcortical.

The club-moss family contains 2 genera and about 100 species, all but one of which belong to Lycopodium, distributed in all parts of the world except the very dry regions. The majority of the epiphytic species are tropical, but several terrestrial species extend to the arctic circle. Twelve of the species are native in the eastern United States. The family is not closely related to any other. The habit, the undifferentiated spores, and the prothallium are distinctive.

The branching of Lycopodium is of two types, the dichotomous, and the monopodial (a central axis from which lateral branches arise). On these types subgenera are based.

The spores of Lycopodium (principally of *L. clavatum*), which are produced in great quantities, are used by apothecaries for coating pills, and by metal-workers. These spores are highly inflammable and were formerly used in theaters to produce flashlights. *L. Selago* is emetic, drastic, vermifugal, and emmenagogue. *L. myrsinitis* and *L. catharticum* are purgative. Several other species have been used locally for various complaints. The creeping stems of *L. clavatum* and *L. complanatum* are often used for Christmas and church decorations.

Several species of Lycopodium (Club-moss, Ground Pine, Creeping Pine) are gathered or protected in America for decorative purposes or for the spores.

Order 7. SELAGINELLALES

14. **Selaginellaceæ** (from the genus *Selaginella*, diminutive of *Selago*, ancient name of Lycopodium). SELAGINELLA FAMILY. Fig 1. Moss-like or lycopodium-like plants, often of moderate size, usually profusely and dichotomously branched, more rarely monopodial; creeping, pendent or erect, sometimes climbing and several meters long, or minute and 1–3 cm. long: leaves moss-like, very small, usually densely placed, often imbricated, often of two sizes (the branches therefore strongly dorsiventral); ligule present, borne at the base of the leaf on the upper side: roots borne on "rhizophores" which are probably modified branches: spores of two sorts (microspores and macrospores) in separate sporangia, borne in the leaf axils: sporophylls frequently modified, forming a cone or spike: prothallia

endosporous, the spore wall of the macrospores soon rupturing and exposing the archegonia.

The one genus, Selaginella, and about 500 species are widely distributed, but mostly tropical. The majority prefer damp forests, but some (e.g., *S. rupestris*) are xerophytic. Three species are native in the eastern United States. The family is related to the Lycopodiaceæ superficially, but not in the spores and in the prothallia, which are more closely allied to another family, the Isoetaceæ. The habit, the foliar ligule, the undifferentiated spores, and the endosporous prothallia are distinctive.

The spores of Selaginella have been used in the same manner as those of Lycopodium, but are less easily obtainable. *S. concinna* and *S. obtusa* have been used for diarrhea and dysentery. Several Mexican species are used locally for medicine. *S. convoluta* is employed in the East Indies as an aphrodisiac. The rosette-like *S. lepidophylla* of Mexico is the best-known "resurrection plant." When dry, it rolls into a ball and becomes brown; when the air is humid, the branches spread out and the green upper surfaces are exposed.

Many species of Selaginella are in choice American collections, but very few are commonly in the trade. They are mostly grown for greenhouse and for table decoration under the name of "lycopodium."

SPERMATOPHYTA or SIPHONOGAMIA (PHANEROGAMIA)

SUB-DIVISION I. GYMNOSPERMÆ

Order 8. CYCADALES

15. **Cycadaceæ** (from the genus *Cycas*, the Greek name of a certain palm). CYCAS FAMILY. Fig. 4. More or less woody plants, with thick, unbranched, columnar or tuberous stem: leaves alternate, pinnate: stamens and carpels borne in cones or in temporarily terminal clusters: scales of the staminate cone bearing very many scattered anthers on the under side: the carpels open, not forming a closed ovary, either leaf-like pinnatifid and bearing marginal ovules, or peltate with 2 or more suspended ovules; the latter very large, often 1 inch long, orthotropous, with 1 integument, becoming drupe-like.

Cycadaceæ has 9 genera and about 85 species, distributed in tropical and subtropical regions. Zamia is the largest genus, with 30 species. The family stands isolated among the gymnosperms. The palm-like habit, pinnate leaves, very numerous scattered stamens, and, in Cycas, the leaf-like carpel, are distinctive. Differences more important to the morphologist are to be found in the embryology, especially in the fertilization by motile sperm-cells. The leaves are circinate when unfolding, like those of a fern. The Cycadaceæ represent an ancient family far more numerous in past geologic ages. Many fossil species are known.

Various species of Cycas in the Moluccas and Japan, especially *C. revoluta*, yield a sago in the pithy part of the stem which the natives bake into bread. The Hottentots eat the pith of Encephalartos, making from it "Kafir bread." The seeds of Cycas and Zamia are edible. The leaves of Cycas are used at funerals and church festivals as "palm branches."

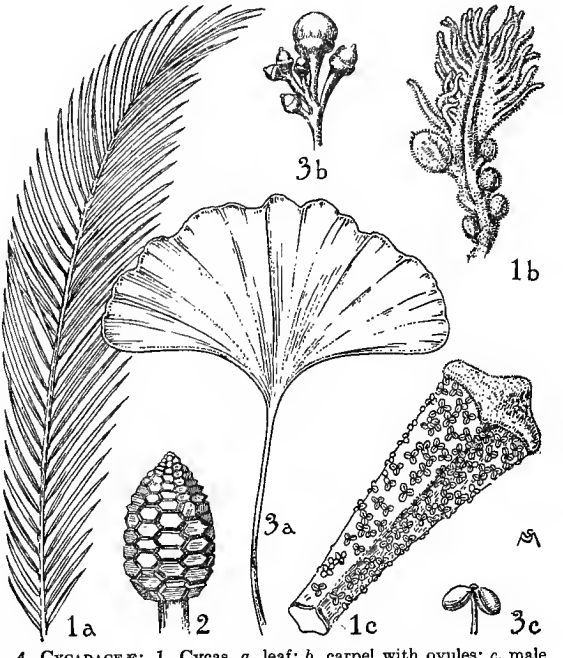
Several genera are in cultivation in America for greenhouse use and outdoors in the South. These are Bowenia; Ceratozamia of Mexico; Cycas (Sago Palm) of the far East; Dioon of Mexico; Encephalartos of South Africa; Macrozamia of Australia; Stangeria of South Africa; Zamia (Coontie, Comptie) of tropical America.

Order 9. GINKGOALES

16. **Ginkgoaceæ** (from the genus *Ginkgo*, the Japanese name). GINKGO FAMILY. Fig. 4. Much-branched tree with deciduous leaves: secondary wood without true vessels; resin-tubes present: leaves alternate, fan-shaped like the pinnules of Adiantum; veins forking: anthers borne in pedicelled pairs on a slender axis, without bracts, the whole somewhat catkin-like: no true pistillate cone; ovules borne in pairs at the summit of branched peduncles, each ovule surrounded at the base by a fleshy ring: fruit drupaceous. Fertilization is by means of motile sperms.

A single genus of one species occurs in China and Japan. Fossil species are known. The family is distantly related to the Coniferæ, but the peculiar foliage, as well as the absence of cone structure and the great reduction of sporophylls, is distinctive.

Ginkgo biloba (ginkgo, maidenhair tree, Kew tree), the only species, is grown as a park tree.



4. CYCADACEÆ: 1. Cycas, *a*, leaf; *b*, carpel with ovules; *c*, male scale with anthers. 2. Zamia, female cone. GINKGOACEÆ: 3. Ginkgo, *a*, leaf; *b*, ovules; *c*, stamen.

Order 10. CONIFERALES

17. **Taxaceæ** (from the genus *Taxus*, the classical name, probably from the Greek meaning *bow*, for which the wood is used). YEW FAMILY. Fig. 5. Much-branched trees or shrubs, with resin-tubes in the bark and no true vessels in the secondary wood: leaves alternate, needle-like or scale-like, persistent: stamens borne on the protected portion of more or less apically thickened or peltate scales (sporophylls) forming a small cone: pistillate cones wanting; ovules borne singly or two together on a fleshy or rudimentary carpel (sporophyll), inverted or straight, the outer integument forming an arillus: fruit a dry seed surrounded by the fleshy often highly colored arillus; the receptacle also often enlarged and forming a fleshy part of the fruit.

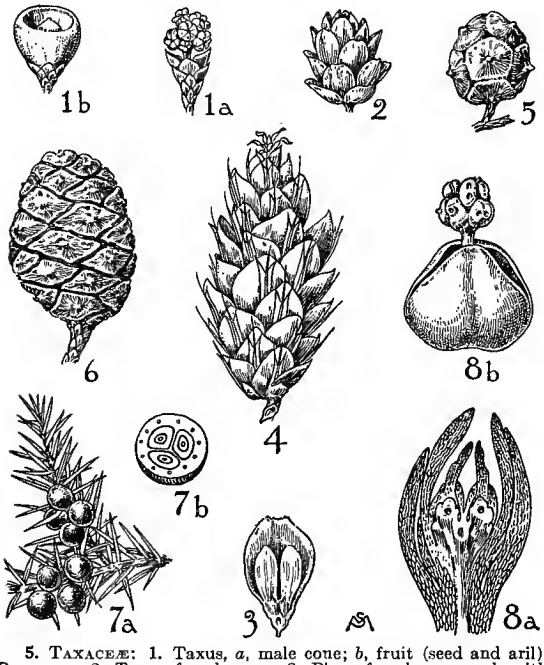
Taxaceæ has 8 genera and about 70 species widely distributed, of which 40 belong to the genus Podocarpus. The family is related to the Coniferæ, but differs in the reduction of the pistillate cone to a single ovule, in the modification or suppression of the sporophyll, and in the aril or arillus. The closely related Ginkgoaceæ has a different staminate inflorescence. Fertilization is by means of pollen-tubes.

The timber produced by the tropical eastern species of Podocarpus and of Dacrydium (heron pine and

damion pine) is highly valued. The yew wood is hard and susceptible of a high polish. It is used in cabinet work and for bows. The seed and shoots of yew are said to be poisonous, but the arillus is harmless.

In cultivation in America are a few genera for ornamental purposes: Cephalotaxus, East Asia; Podocarpus, Chile, Japan, Australia, grown in the South; Taxus (Yew), Europe, Asia, North America; Torreya (California Nutmeg), California to Florida.

18. **Pinaceæ** (from the genus *Pinus*, the classical Latin name). PINE FAMILY. Fig. 5. Tree or shrub, with no true vessels in the secondary wood, but with resin-tubes: leaves linear, or needle-like, or scale-like, alternate or opposite, evergreen or deciduous: anthers and ovules both in true cones plainly subtended by scales (sporophylls); the staminate scales usually bearing 2–6, rarely more, anthers on the under side; the pistillate bearing 1–2, rarely many, ovules on the upper side, or peltate and ovule-bearing under the crown or at its base; ovules with 1 integument: fruit



5. TAXACEÆ: 1. Taxus, *a*, male cone; *b*, fruit (seed and aril). PINACEÆ: 2. Tsuga, female cone. 3. Picea, female cone-scale with ovules. 4. Pseudotsuga, female cone. 5. Chamæcyparis, female cone. 6. Sequoia, female cone. 7. Juniperus, *a*, female cones (berries); *b*, cross-section berry. GNETACEÆ: 8. Ephedra, *a*, female inflorescence; *b*, male inflorescence.

a dry woody cone with dry, often winged seeds between the scales; or berry-like through the union of the fleshy cone-scales.

Sub-family 1. Cupressineæ.—Cone-scales opposite; ovules erect: leaves opposite or whorled.

Sub-family 2. Abietineæ.—Cone-scales alternate; ovules inverted: leaves alternate.

There are 25 genera and about 240 species, widely distributed but most abundant in temperate regions. The largest genus is Pinus with 70 species. The family is related to the Taxaceæ and Ginkgoaceæ, from which it differs in the presence of true staminate and pistillate cones. It also differs from the latter in the absence of motile sperm-cells.

The Pinaceæ, like other Gymnosperms, is an old group, more abundant in former geologic ages. Many fossil species are known. The Sequoias of California were formerly more abundant, extending to Greenland. The young plants of many Cupressineæ possess foliage quite different in appearance from the mature foliage, the leaves being longer and more spreading. These juvenile forms have been called Retinisporas, a name which has been applied also to all cultivated species of Chamæcyparis. Juniper "berries" are fleshy cones with peltate, fused scales. The leaves of Larix, Pseudolarix and Cedrus are deciduous. The branchlets and leaves are deciduous in Taxodium. The cone-scales of many Abietineæ are double, an outer thinner 3-toothed scale, and a thick inner scale that bears the ovules (see *Pseudotsuga*).

Among the Pinaceæ are some of our most valuable timber trees; e. g., cedar, arborvitæ, spruce, fir, hemlock and redwood. The resin from various pines when distilled yields spirits of turpentine and rosin; when dry-distilled, it yields tar. Venice turpentine is the resinous exudation of European larches: Canada balsam that of *Abies balsamea*. Dammar resin is from the Malayan *Agathis Dammara*. Kauri resin is the semi-fossilized resin of *Agathis australis* of Australia and New Zealand. Sandarac resin is from *Callitris quadrivalvis* of Northwest Africa. Amber is the fossilized resin of prehistoric conifers around the Baltic. Oil of savin is from the leaves and twigs of *Juniperus sabina*, and oil of cedar from *Thuya occidentalis*. Juniper berries, from *J. communis* of Europe and America, are diuretic and also used for flavoring gin. Edible seeds are produced by *Pinus Pinea* (stone pine) of the Mediterranean, *P. Cembra* of Europe and Siberia, *P. Parryana* and *P. edulis* of the southwestern United States, *Podocarpus neriifolia* of the East Indies, *Araucaria braziliana* of Brazil, and *A. Bidwillii* of Australia. Bread is made by the Laps and Eskimos from the inner bark of *Pinus sylvestris* and *Abies alba;* also from various Pinaceæ by our northwestern Indians. Deodar (*Cedrus Deodara*) is sacred to the Hindoos. *Cedrus Libani* is the cedar of Lebanon. Pine bark was formerly used for tanning.

Many genera are in cultivation in America. Among these are: Abies (Fir, Balsam); Araucaria (Norfolk Island Pine, Monkey Puzzle); Callitris (Cypress Pine); Cedrus (Cedar of Lebanon, Deodar); Chamæcyparis (White Cedar, Yellow Cedar, Hinoki Cypress, Sawara Cypress, Retinispora, Japanese Cedar); Cryptomeria; Cupressus (Cypress, Monterey Cypress); Juniperus (Red Cedar, Juniper, Savin); Larix (Larch, Tamarack, Hackmatack); Libocedrus (Incense Cedar, White Cedar); Picea (Spruce); Pinus (Pine, Pinnon, Soledad); Pseudolarix (Golden Larch); Pseudotsuga (Douglas Spruce, Red Fir); Sciadopitys (Umbrella Pine); Sequoia (Big Tree of California, Redwood); Taxodium (Bald Cypress, Deciduous Cypress); Thuya (Arborvitæ, White Cedar); Thuyopsis; Tsuga (Hemlock Spruce).

Order 11. GNETALES

19. **Gnetaceæ** (from the genus *Gnetum*, derived from *Gnemon*, said to be the old Malay name of the plant). GNETUM FAMILY. Fig. 5. Very peculiar semi-woody plants of diverse habit: leaves large and broad, or modified, or reduced, or opposite, or whorled: no resin-tubes in the stem; secondary wood containing true vessels: true flowers present, with a 2–4-parted perianth, unisexual, rarely bisexual; stamens 2–8; pistillate perianth becoming juicy or wing-like in fruit and inclosing one naked orthotropous seed with 1 or 2 integuments.

The family consists of 3 genera and about 35–40 species, widely distributed. It is distinguished from the Coniferæ by the presence of a perianth, the absence of resin-tubes, and the presence of vessels in the secondary wood. The endosperm development, also, approaches that of the Angiosperms. The fertilization is by means of pollen-tubes. The three genera are very distinct: Ephedra, of the tropics of both hemispheres, is much branched, with slender jointed striate

equisetum-like stems, leaves scale-like at the distant nodes; Gnetum of South America, except one species, is a group of vines or shrubs with large broad leaves like those of an Angiosperm; Welwitschia of South Africa is a desert plant with a thick subterranean stem bearing two ribbon-like leaves 6 feet long, lying flat on the ground, and with a terminal cluster of cone-like flower-spikes.

It is doubtful whether any of these are regularly in the American trade.

SUB-DIVISION II. ANGIOSPERMÆ

CLASS I. MONOCOTYLEDONEÆ

Order 12. PANDANALES

20. **Typhaceæ** (from the genus *Typha*, the old Greek name). CATTAIL FAMILY. Fig. 6. Perennial marsh herbs, with creeping rootstocks, and long-linear, erect, mostly basal leaves: flowers monœcious, naked, in a dense terminal spike, which is staminate above and pistillate below, each sex subtended by one bract-like spathe; perianth 0; stamens 2–5; filaments connate, bearing long, silky hairs; carpels 1; ovary 1-celled, raised on a stipe which also bears long, silky hairs; ovule 1, suspended; style slender: fruit a nutlet; seed albuminous.

A single genus and about 12 species occur in the tropical and temperate zones. Fossil species are known. The family is closely related to the Sparganiaceæ, with which it was formerly united. These two families constitute a very distinct group of simple-flowered Monocotyledons. The habit, the flowers borne in spikes without perianth, the hairy pedicels, the absence of bracts, and the simple pistil, are together distinctive.

The starchy rootstocks are sometimes used for food. The leaves are woven into matting, and into chair-bottoms, and are used for calking barrels. The pollen has been used as a substitute for the spores of Lycopodium. The rootstock is used in East Asia for dysentery and urethritis, and the leaves in various localities for thatching cottages. A vain attempt has been made to utilize the silky hairs of the fruit for making velvet.

Two species of Typha (Cattail Flag, Reed Mace), both native, are in the American trade for water-gardens.

21. **Pandanaceæ** (from the genus *Pandanus*, derived from a Malay name). SCREW-PINE FAMILY. Fig. 6. Shrubby or arborescent plants: stems simple or branched, with prop-roots: leaves spirally arranged, densely placed, sword-shaped, often canaliculate, clasping, stiff; edges and midrib often spiny-serrate: flowers on simple or branched spadices, dicœcious, naked; spathes caducous; stamens densely packed, separated or united in fascicles, scattered over the spadix, and not in definite flowers; pistillate spadix simple; ovaries numerous, coherent in bundles, or isolated, not in real flowers; stigma sessile; ovules solitary or several: fruit drupaceous, cohering in multiple fruits; seed albuminous.

There are 3 genera and about 350 species, natives of the tropics of the Old World. The family is unique. The floral structure, while much like that of Typha, suggests also the Palmaceæ. As in Typha, actual flowers cannot here be distinguished.

The fleshy pericarps of some are eaten. The strong odor of the staminate flowers is either agreeable or disagreeable, depending on the species; in the former case the flowers are used for perfumery. The leaves of *Pandanus utilis* are made into bags for shipping coffee, and the plant is now cultivated for that purpose in the West Indies.

Ten to 15 species of Pandanus (Screw Pine, Candelabrum Tree, Chandelier Tree) are in greenhouse cultivation in America.

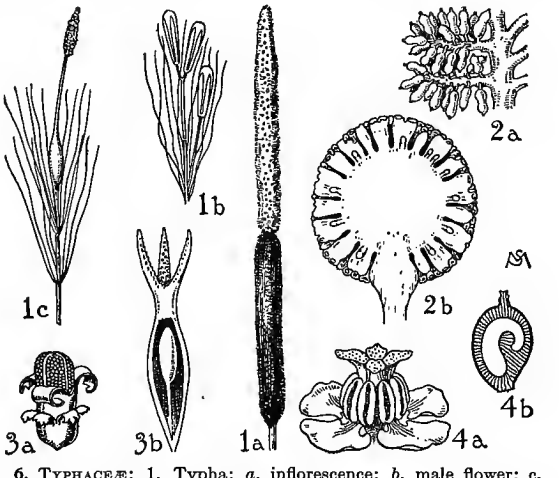
Order 13. HELOBIÆ

22. **Naiadaceæ** (from the genus *Naias*, derived from the Greek, meaning a *water nymph*). PONDWEED FAMILY. Fig. 6. Immersed aquatic herbs: leaves mostly cauline, opposite or alternate, the floating often differing from the submerged in shape and texture: flowers axillary or spicate, bisexual or unisexual; perianth of 4 herbaceous segments, or wanting; stamens 1–4, rarely more; carpels 1–9, mostly distinct, 1-celled, 1-ovuled: fruit a nutlet; endosperm none; embryo curved, rarely straight.

Naiadaceæ has 10 genera and about 100 species widely distributed, but most abundant in temperate regions. The largest genus is Potamogeton with 50 species. The family is a very heterogeneous one which has been divided or united in many ways by different authors. As here treated it is distinguished by the aquatic habit, greenish, often reduced perianth, few stamens, and few, separate, 1-seeded carpels. A spathe-like bract usually incloses the inflorescence.

The dried leaves of Zostera and Posidonia have been used since ancient times in Venice to pack glassware. They are now widely used for packing. Plants of Potamogeton and Zostera are employed as manure.

Several species of Potamogeton (Pondweed) and one of Zannichellia are possibly in the American trade, for water-gardens.



6. TYPHACEÆ: 1. Typha: *a*, inflorescence; *b*, male flower; *c*, female flower. PANDANACEÆ: 2. Pandanus, *a*, portion male inflorescence; *b*, female inflorescence, vertical section. NAIADACEÆ: 3. Naias; *a*, male flower; *b*, female flower. 4. Potamogeton; *a*, flower; *b*, vertical section nutlet.

23. **Aponogetonaceæ** (from the genus *Aponogeton*, derivation obscure). APONOGETON FAMILY. Aquatic herbs with tuberous rhizomes, and basal, submerged or floating leaves; blade linear to oval, palmately parallel-veined, with transverse veinlets; the general tissue between the veins often wanting, thus producing a remarkable openwork latticed effect: flowers spicate, bisexual, regular, hypogynous; perianth of several petaloid parts; stamens usually 6, rarely more; carpels mostly 3, rarely 4–6, separate; ovules 2–6, mostly basal, anatropous: fruit pouch-like; endosperm none.

The single genus, with its 15 species occurs in Africa, Madagascar, tropical Asia and Australia. The family is related to the Naiadaceæ, with which it was formerly united, and from which it is distinguished by the petaloid perianth, several ovules, and straight embryo.

The roots are sometimes eaten by natives.

Aponogeton distachyus (Cape pondweed, water hawthorn) is cultivated in water-gardens.

24. **Alismaceæ** (from the genus *Alisma*, the Greek name). WATER-PLANTAIN FAMILY. Fig. 7. Herbace-

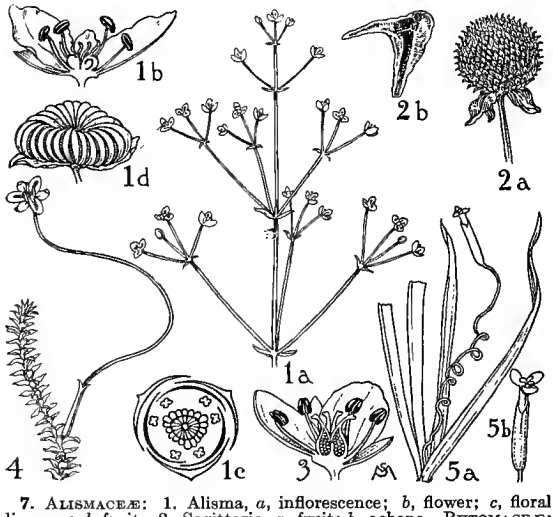
ous marsh plants with milky juice: leaves mostly basal, sheathing, with a scale in the axil; blade various, floating or erect, often sagittate, varying in size and width with the depth of the water, palmately parallel-veined with cross veinlets: flowers bisexual or unisexual, regular, hypogynous, in whorls of 3; sepals 3, more or less hyaline; petals 3, white and petaloid; stamens 6 to many, in several whorls; carpels very many, separate or rarely coherent, spirally arranged or in a whorl, 1-ovuled, rarely 2–5-ovuled: fruit dry, rarely dehiscent; seed basal, anatropous, exalbuminous; embryo curved.

The family has 10 genera and about 50 species, distributed throughout the warmer and temperate zones. The family is related to the Butomaceæ and Juncaginaceæ, which are all peculiar in having an axillary intravaginal scale. The whorled flowers, differentiated perianth, numerous carpels, and mostly solitary, basal, exalbuminous seeds are distinctive.

The acrid juice formerly led to the occasional use of these plants in medicine. The tubers and rhizomes of Sagittaria were eaten by the American Indians as wappato, and are cultivated in China. They are said to come into the Chinese market at San Francisco, preserved in liquid.

Two genera are in cultivation for water-gardens: Alisma (Water Plantain), native; and Sagittaria (Arrowhead), some native.

25. **Butomaceæ** (from the genus *Butomus*, signifying *ox + to cut*, in reference to the rough leaves). Fig. 7. Aquatic or marsh herbs: leaves basal, with an axial scale, sometimes with milky juice; blade linear or oval; veins palmately parallel with cross veinlets, or nearly veinless: flowers solitary or umbelled, bisexual, regular, hypogynous; sepals 3, subherbaceous; petals 3, colored, imbricated; stamens 9 or more, whorled; carpels 6 or more, separate; ovules numerous, borne



7. Alismaceæ: 1. Alisma, *a*, inflorescence; *b*, flower; *c*, floral diagram; *d*, fruit. 2. Sagittaria, *a*, fruit; *b*, achene. Butomaceæ: 3. Butomus, flower. Hydrocharitaceæ: 4. Elodea, female flower branch. 5. Vallisneria, *a*, habit and flower; *b*, female flower.

between the margins and midrib of the carpel: fruit dry, dehiscent; seed anatropous, exalbuminous; embryo straight or curved.

The family contains 4 genera and about 5 species, natives of the temperate and tropical zones of the Old World, and the tropics of the New World. The family is related to the Alismaceæ and Juncaginaceæ, from the former of which it differs principally in the numerous ovules and their peculiar position.

The roots and seeds of Butomus were once used as emollients. The baked roots of Butomus are eaten in North Asia.

Two genera are in cultivation for water-gardens: Butomus (Flowering Rush), and Limnocharis (Water Poppy).

26. **Hydrocharitaceæ** (from the genus *Hydrocharis*, derived from the Greek meaning *water* and *rejoice*). Frog's-Bit Family. Fig. 7. Submerged aquatic herbs, rarely floating, the flowers usually at first inclosed by a 2-bracted spathe: leaves alternate or opposite, very diverse, cordate, linear or ribbon-like: flowers usually unisexual, regular, epigynous; perianth in 2 series, composed of 3 imbricated or valvate, calicoid parts, and 3 convolute petaloid parts, rarely of only 3 divisions; stamens in 1 to several series of 3, some often staminodia; carpels 2–15; ovary inferior, 1-celled with parietal placentæ, or imperfectly several-celled; stigmas 3–6: fruit not regularly dehiscent, submerged, somewhat fleshy; seeds many, exalbuminous.

There are 14 genera and about 40 species widely distributed. The family is related to the Alismaceæ and Naiadaceæ. The differentiation into calyx and corolla, the usually numerous stamens, the inferior, 1-celled ovary with parietal placentæ, and the exalbuminous seeds are together characteristic. The plants of this family are very diverse in appearance and often striking. Fossil species are known. The pollination of Vallisneria is very remarkable. (See Kerner and Oliver, "Natural History of Plants").

Elodea canadensis, introduced into Europe from America, has there become so abundant as to impede navigation. The plants of Hydrocharis, Stratiotes, and Elodea are used as fodder and as manure in Europe. The starchy rootstocks of Ottelia and Boottia are eaten in India as pot-herbs; also the tubers and fruits of Enalus. The fibers from the leaves of Enalus are used in India. *Vallisneria alternifolia* is employed in India in the preparation of sugar.

Five genera are in cultivation in America, mostly for aquaria: Elodea (Waterweed, Ditch-Moss, Water Thyme, Water Pest); Hydrocharis (Frog's-Bit); Limnobium (American Frog's-Bit); Stratiotes (Water Soldier, Water Aloe); Vallisneria (Eel-Grass, Tape-Grass).

Order 14. Glumifloræ

27. **Gramineæ** (from the Latin signifying *grass*). Grass Family. Fig. 8. Herbs, or sometimes almost tree-like: stems hollow or solid: leaves usually linear, in 2 ranks; composed of a sheath which is usually open down the front, a sessile blade, and a ligule at the juncture of blade and sheath: flowers bisexual or unisexual, naked, or with the perianth reduced to 1–3 tiny scales, borne in specialized spikelets composed of 3 or more 2-ranked scales, the first 2 empty (called empty glumes), the others termed flowering glumes or lemmas, and 1 scale on each secondary flower-bearing axis, called a palet or palea; stamens 2–3, exserted for wind-pollination; carpel 1; ovary 1, 1-celled, 1-ovuled; stigmas feathery, usually 2: fruit a caryopsis; seed with endosperm, and embryo with an absorbing organ.

Gramineæ is a family of 300–400 genera and perhaps 5,000 species distributed all over the earth. The largest genera are Panicum with 300–400 species, Paspalum with 160 species, and Poa with 100 species. The Gramineæ and Cyperaceæ form a very distinct group. The usually hollow stem, the open sheaths, the ligule, the 2-ranked leaves, and the peculiar spikelet-structure are the best characters to separate Gramineæ from Cyperaceæ. The Indian corn is one of the most modified of grasses. It is monœcious. The staminate spikelets are arranged on finger-like branches of the tassel at the summit of the plant; the pistillate spikelets are borne on the cob, which is supposed to be composed of similar finger-like portions grown together. Each spikelet is 2-flowered, but only 1 flower bears an ovary. The kernel is this ovary, and the chaff on the cob represent the glumes and palets. The grasses are divided into 13 tribes.

The grasses are among the most useful of plants. The following, among others, are, or have been, used as medicine: Rhizome of *Agropyron repens* (quick- or quack-grass) is emollient, and aperient (several other grasses have the same properties). Root of *Arundo Donax* (reed) is diuretic and sudorific. *Phragmites communis* was formerly considered depurative and anti-syphilitic. Calamagrostis was used by the French peasants as a diuretic. *Perotis latifolia* is used in India for the same purpose, as are also the seeds of *Coix Lacryma-Jobi* in China. The roots of *Manisuris granularis* are used in India for intestinal troubles. The aromatic, fragrant roots of various Andropogons (or Cymbopogons) are used for medicine and for perfume in India and elsewhere, e. g., *A. Nardus* (false spikenard, citronella), *A. citratus* (lemon-grass). *A. lanier* and *A. Schœnanthus* (sweet rush, ginger-grass, geranium-grass) are used in Africa and Arabia as a stimulant, antispasmodic and diaphoretic, and for perfume.

The following are used for food: Seeds of wheat, barley, rye, oats, riee, Indian corn and millet; also seeds of *Andropogon arundinaceus* var. *vulgare* (sorghum), and var. *Durra* (durra). *Pennisetum americanum* (pearl millet) is an important food of the negro races, and *Poa abyssinica* and Eleusine are important in East Africa. Sugar is obtained from the stems of several species, most important of which are *Saccharum officinarum* (sugar-cane), and *Andropogon arundinaceus* var. *saccharatus* or *A. Sorghum* (sugar sorghum).

Many grasses are used as fodder for cattle, as, for instance, our pasture and hay grasses: *Poa pratensis* (June grass, Kentucky blue grass), *Phleum pratense* (timothy), *Festuca ovina*, etc. (fescue), *Agrostis alba* (red-top), *Dactylis glomerata* (orchard-grass), *Cynodon Dactylon* (Bermuda-grass). Some grasses are poisonous to stock, e.g., *Lolium temulentum* (darnel), and the Peruvian *Festuca quadridentata*.

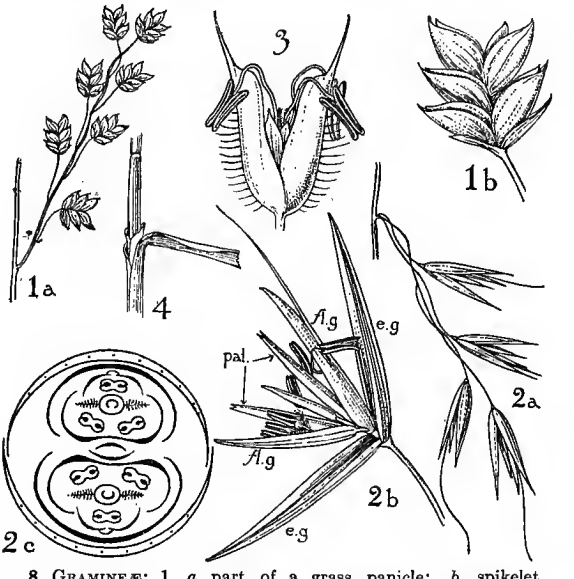
Straw from cereals is used for matting, upholstery, bedding, hats and for making paper.

The bamboos yield very important building material in the East. Like the palms, the bamboos are used for almost every conceivable purpose, and are among the most useful of plants.

Several grasses, other than those above mentioned, contain a fragrant prineiple, e. g., roots of *Vetiveria zizanioides* (vetiver or kus-kus of India) used to perfume rooms, and to keep insects out of clothing. *Hierochloe odorata* (vanilla- or holy-grass) is used in Europe in religious ceremonies, and by the American Indians for making baskets. *Anthoxanthum odoratum* is the European sweet-grass, now introduced into America.

The most important ornamental species are *Phalaris arundinacea, Stipa pennata, Cortaderia argentea, Lagurus ovatus, Hordeum jubatum, Miscanthus sinensis*, Briza, Arundo, Phragmites, Erianthus, Pennisetum, Thysanolæna, and Bamboos.

In America 70–80 genera are cultivated, or are important as natural fodder plants or weeds. Among these are: Agropyron (Quack-Grass, Coueh-G., Quick-G.); Agrostis (Bent-G., Red-Top, Cloud-G., Tickle-G., Fly-away-G.); Aira (Hair-G.); Andropogon (Silver-beard-G., Johnson-G., Lemon-G.); Anthoxanthum (Sweet Vernal-G.); Ammophila (Beach-G., Marram-G.); Arundinaria (Large Cane, Switch Cane, Scotch Cane); Arundo (Giant Reed); Avena (Oats); Bamboo; Briza (Quaking-G.); Bromus (Brome-G., Rescue-G.); Calamagrostis (Reed Bent-G., Blue-joint-G., Pony-G.); Calamovilfa (Purple Bent-G.); Cenchrus (Sand-bur, Bur-G.); Chloris (Finger-G.); Cinna; Coix (Job's Tears, Tear-G., Corn Beads); Cortaderia (Pampas-G.); Cynodon (Bermuda-G.); Cynosurus (Crested Dog's-tail, Silky-awned Dog's-tail); Dactylis (Cock's-foot, Orchard-G.); Dactyloctenium (Crowfoot-G.); Desmazeria (Spike-G.); Deschampsia (Hair-G., Hassock-G.); Digitaria (Crab-G., Finger-G.); Distichlis (Salt-G., Marsh Spike-G.); Echinochloa (Barnyard-G.); Eleusine (Crab-G., Yard-G., Dog's-tail, Wire-G., African Millet); Elymus (Lyme-G., Wild Rye, Terrel-G.); Eragrostis; Erianthus (Woolly Beard-G., Plume-G., Wool-G., Ravenna-G.); Euchlæna (Teosinte); Festuca (Fescue-G.); Glyceria or Panicularia (Reed Meadow-G., Manna-G.); Cortaderia; Hierochloe (Vanilla-G., Holy-G., Seneca-G., Sweet-seented-G.); Holcus (Meadow Soft-G.); Hordeum (Squirrel-tail-G., Wild Barley, Barley); Hystrix or



8. Gramineæ: 1. *a*, part of a grass panicle; *b*, spikelet. 2. Avena, *a*, portion of panicle; *b*, spikelet; *e.g.*, empty glume; *fl.g.*, flowering glume or lemma; *pal.*, palet or palea; *c*, ground-plan of spikelet. 3. Phleum, spikelet. 4. Phalaris, sheath and ligule.

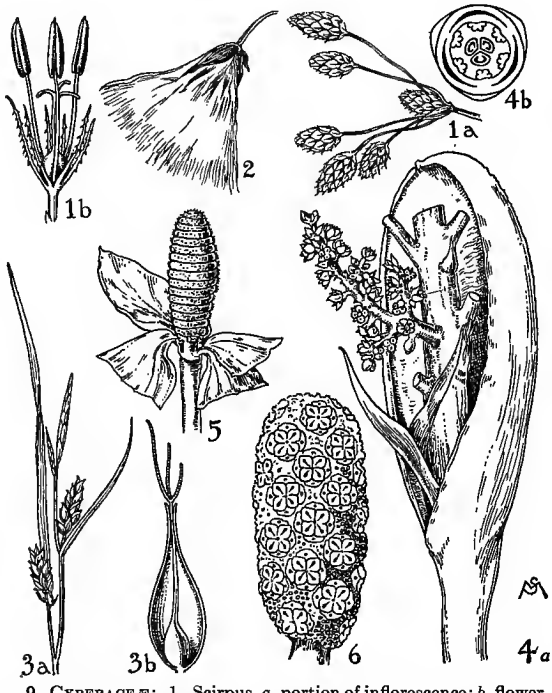
Asprella (Bottle-G.); Lolium (Darnel, Rye-G.); Milium (Wild Millet-G.); Miscanthus (Eulalia, Himalaya Fairy-G.); Oplismenus; Oryza (Rice); Oryzopsis (Mountain Rice); Panicum (Panie-G., Old-Witch-G., Millet, Broom Corn Millet); Pennisetum (Pearl Millet); Phalaris (Canary-G., Gardener's Garters); Phleum (Timothy-G., Herd's-G.); Phragmites (Common Reed); Phyllostachys (Bamboo, in part); Poa (Blue-G., Kentucky Blue-G., Meadow-G.); Saccharum (Sugar-cane); Secale (Rye); Setaria (Millet, Hungarian-G., Foxtail-G., Pigeon-G.); Spartina (Cord-G.); Sphenopholis; Stenotaphrum (St. Augustine-G.); Stipa (Feathered-G., Esparto-G., Porcupine-G.); Tripsacum (Gama-G., Sesame-G.); Tritieum (Wheat, Spelt).

28. **Cyperaceæ** (from the genus *Cyperus*, the ancient Greek name). Sedge Family. Fig. 9. Herbaceous plants with grass-like habit and solid stems: leaves alternate, in 3, rarely 2, vertical rows, linear; sheaths closed: flowers bisexual or unisexual, regular, hypogynous, borne in variously disposed spikelets, subtended and hidden by overlapping scales none of which are regularly empty as in the grasses; no true palets; perianth reduced to bristles, scales, or 0; stamens 2–3; carpels 2–3; ovary 1-celled, 1-ovuled; style 1; stigmas 2–3: fruit an achene; seeds basal, anatropous, albuminous.

There are 65 genera and about 3,000 species, inhabiting the whole earth. More than 500 species belong to the genus Carex, 400 to Cyperus, and 200 to Scirpus. They are abundant in swampy regions. The family is closely related to the Gramineæ, from which it differs in the often 3-ranked leaves, solid stem, the absence of palets and of regular empty glumes, and the presence, in most cases, of a perianth and 3 carpels. Most divergent from the ordinary is Carex, the flowers of which are monœcious, and the pistillate, though naked, are inclosed in a flask-shaped structure called a peri-

gynium, which probably corresponds to the modified palet of the grass spikelet. The elongated perianth forms the wool of the wool-grass or cotton-grass. The scales of the spikelet are in 2 ranks in Cyperus and Dulichium; in many ranks in the other genera.

The Cyperaceæ are of far less economic importance than the Gramineæ. The rhizomes of several species of Carex were formerly used as a remedy in syphilis. *Scirpus lacustris* is astringent and diuretic, but other



9. Cyperaceæ; 1. Scirpus, *a*, portion of inflorescence; *b*, flower. 2. Eriophorum, spikelet. 3. Carex; *a*, inflorescence; *b*, vertical section perigynium. Palmaceæ: 4. Chamærops, *a*, spathe and spadix; *b*, floral diagram. Cyclanthaceæ: 5. Cyclanthus, inflorescence. 6. Carludovica, inflorescence.

species also possess this property. The foliage of Eriophorum has been used for dysentery. The spongy pith of the Eriophorum stem was used by German peasants for tapeworm. The tubers of *Cyperus esculentus*, now a weed in all countries, were cultivated by the Egyptians for food. The leaves of many species of Cyperaceæ have been woven into mats, chair-bottoms, and the like. The Egyptians made parchment from the pith of *Cyperus Papyrus*. The rhizomes of *Eleocharis tuberosa* are used in the manufacture of starch, in China and India. *Cyperus scariosus* and *C. pertenuis*, of India, are fragrant and used in making perfumery. Some carices are used in making rugs.

Several genera are in cultivation in America, mostly for water-gardens, table decorations, and the conservatory: Carex (Sedge); Cyperus (Umbrella Palm, Egyptian Paper Plant, Egyptian Papyrus, Chufa); Dulichium; Eleocharis; Eriophorum (Cotton-Grass, Wool-Grass); Mapania; Scirpus (Bulrush Sedge).

Order 15. Principes

29. **Palmaceæ** (from the Latin name *palma*). Palm Family. Fig. 9. Woody plants of various habit, low, or arborescent, or climbing, usually unbranched, sometimes spinescent: leaves forming a crown at summit of stem except in Calamus, alternate, coriaceous, palmately or pinnately veined, entire or pinnatifid or palmatifid, often very large: inflorescence a simple or much-branched spadix, with or without a subtending spathe, the latter often woody; flowers uniscxual, rarely bisexual, often sunk in the spadix; perianth of 6 parts in 2 series, greenish, often woody, valvate in the staminate, imbricated or convolute in the pistillate flower; stamens 6, rarely 3 or many, on or around a disk, separate or united; carpels 3, rarely fewer, separate or forming a 1–3-celled ovary; each cell 1-ovuled, but all except one seed in the ovary may abort; stigmas usually 3: fruit a berry or drupe; pericarp fleshy or fibrous; seeds albuminous.

Palmaceæ has 128 genera and about 1,000 species of tropical distribution; 10–15 species are found in the southern United States. The largest genera are Calamus with about 200 species, Bactris with 90 species and Chamædorea with 60 species. The family is very distinct, having no close relatives, but it evidently belongs to the spathe- and spadix-bearing group. The habit, coriaceous plicate leaves which are entire in the bud, the woody flowers and inflorescence, the 3 sepals and 3 petals, the usually 6 stamens, and the 3 carpels, each with 1 seed, are together distinctive.

Palm leaves are always entire in the bud, and if later pinnatifid or palmatifid, become so on unfolding. In this respect the palms are unique. The leaves are plicate in the bud, and, on opening, the plates of the fan expand and either remain united or, more frequently, split down along the folds. In the pinnate species the rachis between the folds elongates so that the divisions are separated, and the well-known palm leaf is produced. The splitting may be at the top of the fold, or at the bottom, depending on the genus, and is an important characteristic in classification. Some of the largest seeds in the plant kindgom belong to the Palmaceæ, as, for example, the coconut. This fruit is produced from an originally 3-celled ovary, 2 cells of which abort.

Next to the grasses, the palms are the most generally useful of all plants. It is said that probably there is not a species but that is useful in some way. Many yield textile fibers. The wood is used to build houses and the leaves to thatch the roofs. The leaves are also made into mats, baskets, hats, and the like. The fibrous bud-sheaths are used as hats, or for fiber. Some species contain starch or sugar in the trunk. The fruits of many contain sugar, protein, starch, or oil. Comparatively few are medicinal. "The palm is called King of Plants and is said to supply all the wants of an inhabitant of the tropical zone. It yields sugar, milk, solid cream, wine, vinegar, oil, cordage, cloth, cups, wood for building, thatch and other products." Coconuts, the fruit of *Cocos nucifera*, form one of the most important foods of the tropics. The date fruit (*Phœnix dactylifera* of the Sahara) is also important. *Metroxylon Rumphii*, and other species, yield sago. A fermented liquor known as palm wine, laymi or arrack, is made from the juice of *Arenga saccharifera*, *Borassus flabelliformis*, *Metroxylon Rumphii*, *Mauritia vinifera*, and others. The central bud of the cabbage palm and others is used for food. Most palm oil is from the fruit of *Elæis guineensis* of West Africa, which is now cultivated in America. It is used like olive oil, or in the North for making soap. Vegetable wax is obtained from the leaves and stems of *Ceroxylon andicolum* of Peru, also from *Copernicia cerifera* (carnauba wax). The famous giant double coconut is from *Lodoicea sechellarum* of the Seychelle Islands. The fruit of *Areca Catechu* of the East Indies and India yields an astringent juice which, mixed with the leaves of the betel pepper and lime, is chewed by the inhabitants of tropical Asia. Coconut fiber is important for making ship cables. The very slender stems of Calamus, often 300 feet or even 500 feet long (it is reported 1,200 or 1,800 feet, but not verified) and scarcely larger than a pipe-stem or a finger, are called rattan, and used for furniture. Much of the dragon's blood of the druggists

is the red juice of the fruit of *Calamus Draco*. Palm-leaf fans are made from the palmately veined leaves of several species. The saw palmetto (*Sabal serrulata*) of the southern states is medicinal. The seeds of *Phytelephas macrocarpa* have a very hard endosperm known as vegetable ivory, used for carving as a substitute for ivory.

Probably 100 genera are in the trade. Except in the tropics, they are almost entirely ornamental greenhouse plants. Among these are: Areca (Betel Nut); Attalea; Bactris; Calamus; Caryota (Fish-tail Palm, Wine Palm, Toddy Palm); Ceroxylon (Wax Palm); Chamædorea; Cocos (Coco Palm, Coconut, Pindo Tree); Corypha (Talipot Palm); Dæmonorops; Elæis (Oil Palm); Erythea (Blue Palm); Geonoma; Hedyscepe (Umbrella Palm); Howea (Flat Palm, Thatch Leaf Palm, Curly Palm); Livistona; Oreodoxa (Royal Palm, Cabbage Palm); Phœnix (Date Palm); Phytelephas (Ivory Palm); Rhapis; Rhapidophyllum (Blue Palmetto, Needle Palmetto); Sabal (Dwarf Palmetto, Blue Palm, Cabbage Palmetto); Serenæa (Saw Palmetto); Thrinax; Trachycarpus (Fortune's Palm); Washingtonia or Pritchardia (Weeping Palm).

Order 16. Synanthæ

30. **Cyclanthaceæ** (from the generic name *Cyclanthus*, which has reference to the spiral arrangement of the flowers). Cyclanthus Family. Fig. 9. Stemless or caulescent, palm-like, somewhat woody plants, often climbing: leaves alternate, coriaceous, cleft or parted: flowers in a dense terminal unbranched spike (spadix), with several bract-like spathes beneath; staminate flowers grouped in 4 bundles accompanying the pistillate, or both in conspicuous alternating spirals; staminate perianth reduced and fimbriate, or 0; stamens 6 to many, borne in groups; perianth of the pistillate flower 0, or of 4 fleshy parts accompanied by 4 long, twisted, exerted staminodia; carpels 4, united below, sunken in the spadix; ovary 1-celled, many-ovuled, with parietal placentæ: fruit multiple, a berry-like spike. The tissue of the spadix splits into valves, coiling up from the base to apex and thus inclosing the fruitlets which deliquesce.

This family has 5 genera and about 50 species, of which 35 belong to Carludovica. They are confined to the tropics of America, and stand intermediate between the Palmaceæ and Araceæ. The family is distinguished by the combination of palm-like foliage, numerous ovules, thick spadix, and closely associated staminate and pistillate flowers.

The flowers of *Cyclanthus bipartitus* of Brazil are vanilla-scented, cultivated, and cooked with meat as an aphrodisiac. The leaves of *Carludovica palmata* furnish the material for the panama hats.

Several species of Carludovica are in the American trade as greenhouse plants.

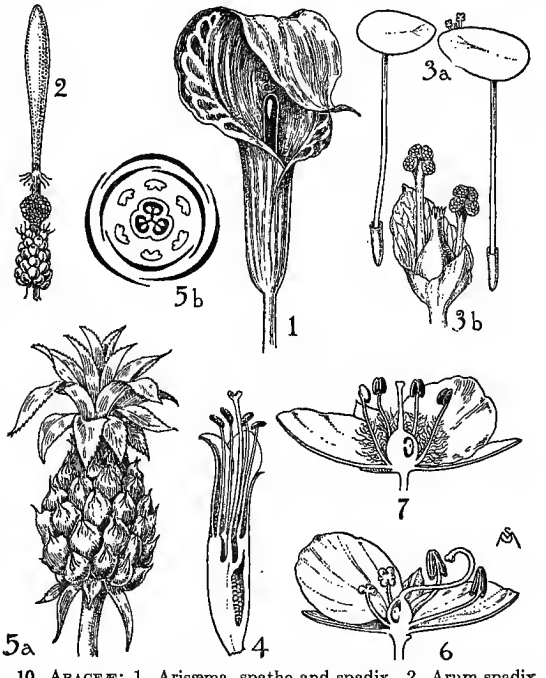
Order 17. Spathifloræ

31. **Araceæ** (from the genus *Arum*, the ancient name of these plants). Arum Family. Fig. 10. Herbs, shrubs, or trees, of the most diverse habit and appearance, often climbing, or epiphytic with aërial roots, rarely floating, usually subfleshy; juice sometimes milky: leaves ensiform or broad, parallel- or netted-veined, entire or variously cut: flowers bisexual or unisexual, rarely reduced to a single stamen and carpel, regular, hypogynous or epigynous, disposed on an unbranched fleshy axis (spadix), which is usually subtended by a special bract (spathe); perianth 0, or of 4–8 parts; stamens 1 to many; carpels 1 to several; ovary superior or inferior, 1 to several-celled, 1 to many-ovuled; style and stigmas various: fruit a berry; seeds albuminous, outer integument fleshy.

Araceæ has over 100 genera and about 900 species, widely distributed, but most abundant in the tropics, especially as epiphytes in the deep, damp forests. The majority in the temperate regions are swamp-plants. The largest genera are Philodendron with 100 species, and Arisæma with 50 species. The family stands as the type of the spathe-bearing plants. Its close relatives are the Lemnaceæ, Palmaceæ, and Cyclanthaceæ, from which it is distinguished more by general habit and texture than by structural details.

The pollination of the Araceæ is often complicated and remarkable (see Kerner and Oliver). The transfer of the pollen is mostly accomplished by flies, which are frequently attracted by lurid color and carrion scent. The leaves of Monstera are remarkable for their peculiar perforations, while the massive petioles of other Araceæ are sometimes mottled like snakeskin Pistia is a much-reduced floating aquatic, transitional to the Lemnaceæ. The aërial roots of the epiphytic species are frequently covered with a special water-absorbing tissue. The unfolding spathes of the Araceæ are noted for the heat evolved. The tissues are usually very mucilaginous and filled with needle-like crystals of calcium oxalate. These crystals are supposed to give the pungent flavor to Indian turnip simply by mechanically penetrating the tongue.

Many species have been used locally for medicine. *Lagenandra toxicaria* of Ceylon is extremely poisonous.



10. Araceæ: 1. Arisæma, spathe and spadix. 2. Arum spadix with male and female flowers. Lemnaceæ: 3. Lemna, *a*, whole plants; *b*, male and female flowers, and spathe. Bromeliaceæ: 4. Bromelia, flower. 5. Ananas, *a*, fruiting inflorescence; *b*, floral diagram. Commelinaceæ: 6. Commelina, flower. 7. Tradescantia, flower.

Dieffenbachia Seguine and *Arisæma triphyllum* are violent irritants when chewed, causing the mouth to swell. *Arum maculatum* of Europe was used by the ancients as an excitant. The roots of Symplocarpus have been used for asthma and colds. The roots of *Acorus Calamus* (sweet flag) are aromatic and used for coughs, colds, and the like. The thick rootstocks and roots of many have been used for food, e. g., *Orontium aquaticum* of North America, *Colocasia antiquorum* of India, *Alocasia macrorhiza* (taro) of the Pacific Islands, and *Peltandra virginica* of North America. The rhizomes of *Arisæma maculatum* and *Calla palus-*

tris, mixed with cereals, according to Linnæus, serve for food among the Laps and Finns. Portland arrowroot is derived from Arums. The delicately flavored, juicy fruits of *Monstera deliciosa* are eaten in Mexico. The shoots of *Xanthosoma sagittifolium*, called caraibe cabbage, are eaten as a vegetable in the Antilles. The aërial roots of aroids are used to tie bundles of sarsaparilla sent to Europe and America.

Because of their odd habit and strange appearance, as well as, in some cases, for real beauty, many Araceæ are in cultivation, mostly as conservatory plants. Many genera are in the American trade. Among these are: Acorus (Sweet Flag); Alocasia; Amorphophallus (Devil's Tongue, Snake Palm, Stanley's Wash-Tub); Anthurium; Arisæma (Indian Turnip, Jack-in-the-Pulpit, Dragon Root, Fringed Calla); Arum (Black Calla, Solomon's Lily, Lord and Ladies, Cuckoo Pint, Wake-Robin of England); Biarum; Caladium; Calla; Colocasia; Dieffenbachia; Helicodiceros (Hairy Arum); Monstera (Ceriman, Shingle Plant); Nephthytis; Orontium (Golden Club); Peltandra (Water Arum); Pistia (Water Lettuce, Tropical Duckweed); Pothos; Sauromatum; Schizmatoglottis; Spathiphyllum; Symplocarpus, or Spathyema (Skunk Cabbage); Xanthosma (Malanga); Zantedeschia, or Richardia (Calla Lily, Lily-of-the-Nile).

32. **Lemnaceæ** (from the genus *Lemna*, an old Greek name of uncertain origin). DUCKWEED FAMILY. Fig. 10. Tiny aquatic plants floating or submerged, the plant body reduced to an oval or oblong, flat or globular thallus, which multiplies rapidly by marginal buds, and may or may not bear 1 or more roots on the under side: flowers unisexual, naked, monœcious; the staminate consisting of 1 stamen; the pistillate of 1 flask-shaped, 1-celled pistil, with several ovules; the latter orthotropous or anatropous, the micropyle transformed into a cap: fruit a several-seeded utricle.

There are 3 genera and about 25 species, distributed over the whole earth, except the arctics. The family is related to the Araceæ, from which it is supposed to have degenerated. The flowers, which rarely occur, are borne in minute pits in the edge or upper surface of the thallus, either 1 staminate and 1 pistillate, or 2 staminate and 1 pistillate together; in some genera provided with a spathe corresponding to the spathe in the Araceæ. The roots, when present, are balancing organs to resist the upsetting of the plant by the waves. Wolffia is the tiniest flowering plant, the whole plant sometimes in size only half the diameter of a pinhead.

By the very rapid vegetative multiplication of some species, ponds are often completely covered with a green coating, and these plants may then become of economic importance.

Lemna and Spirodela are often grown in aquaria.

Order 18. FARINOSÆ

33. **Bromeliaceæ** (from the genus *Bromelia*, in honor of Olaus Bromel, a Swedish botanist). PINEAPPLE FAMILY. Fig. 10. Herbs or subshrubs, mostly epiphytic: leaves usually basal, alternate, linear, trough-like, sheathing at the base, mostly stiff and spiny-serrate, usually covered in part or all over with peltate scale-like hairs or glands: flowers in spikes, racemes, panicles or heads, often in the axils of imbricated, highly colored, bracts, usually bisexual, regular, epigynous or hypogynous; perianth of 6 parts, definitely differentiated into calyx and corolla; parts free or united; stamens 6, often borne on the perianth; anthers introse; ovary inferior or superior, 3-celled; ovules many; style 1; stigmas 3: fruit a berry or capsule, more or less surrounded by the persistent perianth; seeds albuminous.

The family has 40 genera and about 900 species, almost exclusively of tropical and subtropical America. *Tillandsia usneoides* reaches Florida and Texas. Tillandsia is the largest genus with 120 species. The family is closely related to the Liliaceæ and Amaryllidaceæ. The peculiar stiff leaves, the conspicuous bracts, the herbaceous calyx, the mealy endosperm, and, in general, the epiphytic habit, are distinctive. There are few families more easily recognized than this.

The most important economic species is the pineapple (*Ananas sativus*), the fruit of which is an important article of commerce. Its unripe juice is used as a vermifuge and diuretic. Florida or Spanish moss (*Tillandsia usneoides*) is used in the preparation of a stiptic ointment. It is also used to stuff mattresses, under the name of vegetable hair. *Billbergia tinctoria* is the source of a dye. The leaves of pineapple yield a beautiful fiber. *Bromelia Pinguin* is a vermifuge employed in the West Indies.

There are several genera grown in America, all for ornamental purposes except the pineapple. Among these are: Æchmea; Ananas (Pineapple); Billbergia; Bromelia (Pinguin of Jamacia, Wild Pine); Cryptanthus; Dyckia; Guzmannia; Nidularium; Pitcairnia; Tillandsia (Spanish Moss, Florida Moss, Long Moss); Vriesia.

34. **Commelinaceæ** (from the genus *Commelina* dedicated to J. and G. Commelin, Dutch botanists of the early 18th century). SPIDERWORT FAMILY. Fig. 10. Herbs with knotty stems, and somewhat sheathing, alternate, flat or channeled, cauline leaves: flowers usually bisexual, almost or quite regular, hypogynous; perianth of 6 parts, in 2 series, differentiated into a green calyx and colored corolla; the petals separate or united into a tube, mostly quickly disappearing, and dissolving into a viscid liquid; stamens 6, or reduced to 3, with or without staminodia; some anthers often sterile and altered; the filaments usually provided with characteristic long hairs; ovary superior, 2–3-celled, few-seeded; style 1; stigma usually captitate: fruit a capsule.

Twenty-five genera and about 300 species occur, widely distributed in the tropics and subtropics. Eleven species reach the northeastern United States. The largest genus is Commelina, with 88 species. The family is not closely related to any other. The general habit, the complete differentiation of the perianth into calyx and corolla, the slight irregularity of the flower, the peculiar stamen-hairs, and the transformed anthers, are together distinctive. The peculiar deliquescent character of the petals in many genera is of interest.

The rhizomes of several species of Commelina contain starch, besides the mucilage, and are eaten. The rhizome of *C. Rumphii* is an emmenagogue. The tubers of *Aneilema medicum* are used in China for coughs and lung diseases. A decoction of *Cyanotis axillaris* is used by the Indians for dropsy. The family is most important from the point of view of ornamental use.

Several genera are grown in America, all for ornament. Among these are: Aneilema; Cochliostema; Commelina (Day Flower); Dichorisandra; Tradescantia (Spiderwort, Wandering Jew); Zebrina (Wandering Jew).

35. **Pontederiaceæ** (from the genus *Pontederia*, named in honor of Pontedera, professor at Padua in the 18th century). PICKEREL-WEED FAMILY. Fig. 11. Upright or floating, fleshy, water- or swamp-plants: leaves alternate; petioles sheathing; blade cordate, oval, or orbicular, or reduced to the linear flattened petiole: flowers not bracted, bisexual, irregular, hypogynous; perianth of 6 similar parts, in 2 whorls, more or less connate, persistent; stamens 3 or 6, rarely 1, inserted unequally on the perianth-tube; anthers introse; ovary superior, 3-celled and ovules many, or 1-celled and 1-seeded; style 1; stigmas 3: fruit a capsule, or an achene enveloped by the fleshy persistent base of the perianth; embryo as long as the endosperm.

The family contains 6 genera and about 20 species, of which 9 belong to the genus Heteranthera, and about 5 to Eichhornia. They are distributed in the swamps of

II. Vegetation areas.—Aquatic, marsh and upland floras, and the relation of farm lands.

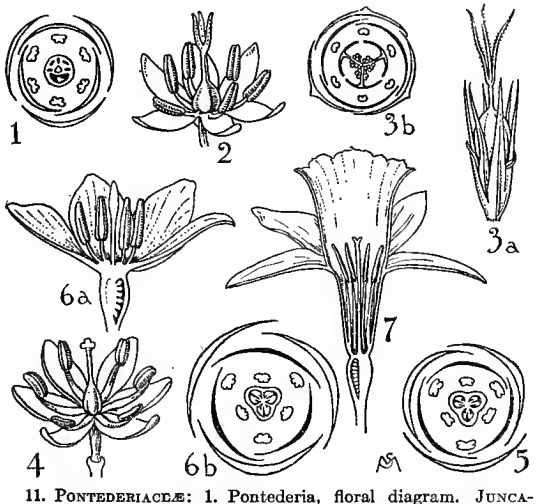
the warmer parts of the earth, except Europe. The family is most closely related to the Liliaceæ, from which it differs in the irregular flowers, in the sympodial method of growth, in anatomical characters, and principally in the abundant mealy endosperm.

A decoction of the root of *Monochoria vaginalis* of the Far East is used for liver and stomach complaints; the root is chewed for toothache; pulverized and mixed with sugar it is used for asthma; the leaves bruised and mixed with milk are used for cholera; and the shoots are edible. *Eichhornia crassipes* is a floating fleshy plant with beautiful flowers. It has become so abundant in Florida as to interfere seriously with steamboat navigation in the rivers. The large violet flowers of both Eichhornia and Pontederia are valued in cultivation for water-gardens.

Two genera are frequent in cultivation: Eichhornia (Water Hyacinth), from South America; and Pontederia (Pickerel-weed), native.

Order 19. Liliflorae

36. **Juncaceæ** (from the genus *Juncus*, classical name, derived from *jungere*, to join). Rush Family. Fig. 11. Rush-like or grass-like herbs or shrubs: flowers numerous, very small, bisexual, regular, hypogynous; perianth of 6 similar, separate parts, greenish or brownish, chaffy; stamens 3 or 6 in 2 whorls; carpels 3; ovary 1-



11. Pontederiaceæ: 1. Pontederia, floral diagram. Juncaceæ: 2. Luzula, flower. 3. Juncus, *a*, flower; *b*, floral diagram. Liliaceæ: 4. Dracæna, flower. 5. Fritillaria, floral diagram. Amaryllidaceæ: 6. Leucoium; *a*, flower; *b*, floral diagram. 7. Narcissus, flower.

or 3-celled; ovules 3 to many; stigmas 3: fruit a capsule; seeds mostly very small, albuminous, anatropous.

Juncaceæ has 7 genera and about 175 species, of which 160 belong to the genus Juncus, widely distributed in temperate and cold regions, both north and south, but rare in the tropics. The family is closely related to the Liliaceæ, from which it differs only in the rush- or grass-like habit and scarious perianth. Fossil species are known. The leaves are sheathing and the blades are either flat, or tubular and nodulose. Distichia of the Andes is densely heath-like or moss-like.

The stems and leaves of many species are used for binding, or for weaving into mats. Light hats are made from the pith of certain species in India and China. The pith is also used for candlewicks.

In cultivation in America are 2 genera for water-gardens: Juncus; Prionium, woody. Xanthorrhœa is transferred to the Liliaceæ.

37. **Liliaceæ** (from the genus *Lilium*, classical Latin name). Lily Family. Fig. 11. Herbs, shrubs, or trees, usually with rootstocks or bulbs, sometimes climbing: leaves alternate, rarely with petiole and blade: flowers bisexual, rarely unisexual, regular, hypogynous, rarely epigynous, not subtended by spathes; perianth petaloid, of 6 similar parts, in 2 series, the parts separate or connate, rarely differentiated into a green calyx and colored corolla; stamens 6, rarely fewer, hypogynous, or borne upon the perianth; carpels 3, rarely more or fewer, united, rarely free; ovary usually 3-celled; ovules 1 to many in each cell; styles and stigmas 1–3: fruit a capsule or berry.

There are about 200 genera and 2,000 species, distributed in all parts of the world. The large genera are Smilax with 200 species, Allium with 250 species, Asparagus with 100 species, Aloe with 85 species and Scilla with 80 species. The Liliaceæ, taken in the broader sense, as is done by Bentham & Hooker, and by Engler, is an easily recognized group except in unusual cases. The regular, 6-parted perianth, 6 stamens, and 3-celled superior ovary are distinctive. The family has been divided by Engler into 11 tribes. The Liliaceæ furnishes a host of cultivated plants.

The following plants, among others, have been or are used in medicine: *Amianthium muscætoxicum* of North America as a narcotic and a fly poison; various species of Uvularia of North America as a gargle and for rattlesnake bites; the root of Polygonatum sp. in Europe as a vulnery, and the berries as an emetic and purgative; the berries of *Smilacina racemosa* of North America as a tonic; the root of *Convallaria majalis* of Europe as a purgative; the leaves of *Streptopus amplexicaulis* of North America as a gargle; the roots of Ruscus of Europe as a diuretic and emmenagogue; the roots of Smilax sp. of the tropics (the sarsaparillas of commerce) as a tonic and diuretic; the roots of *Asparagus officinalis* in Europe as an aperient, the berries as a diuretic and aphrodisiac, and the shoots as a sedative and cardiac; the roots of Cordyline of the southern tropics for dysentery; the flowers of *C. deflexa* as an emmenagogue; the resin from *Xanthorhœa hastilis* (Botany Bay gum, with a fragrance like benzoin) in Australia for throat troubles; the resin of *X. australis* (grass tree gum, earth shellac, or nut pitch) for various purposes; the tubers of *Ophiopogon japonicus* (serpent's beard) in China and Japan for abdominal troubles; the bulbs of Gagea of Europe as an emetic; the flowers of Hemerocallis of Europe as a cordial; the leaves of species of Aloes of the Old World as a tonic, purgative, and emmenagogue (*A. Perryi* is Socotrine aloes, *A. vera* is Barbadoes aloes, and *A. spicata* is Cape aloes); the bulb of *Urginea maritima* (squills) of the Mediterranean as a diuretic, expectorant, and emetic; Allium sp. as a vermifuge and carminative; the bulbs of Hyacinthus, Muscari, and Ornithogalum of Europe as purgatives and diuretics; *Ornithogalum altissimum* of the Cape as a remedy for asthma and catarrh; Antherieum and Asphodelus as diuretics and emmenagogues; Tulbaghia of the Cape as a vermifuge and for phthisis; the poisonous root of *Veratrum album* (white hellebore) of Europe as a violent purge and emetic, and to exterminate vermin; *V. nigrum* (black h.) of Europe, and *V. viride* (green h.) of the United States, occasionally, for the same purpose; *Schœnocaulon officinalis* (cavadilla or sabadilla) of Mexico for vermin and as a vermifuge; the narcotic, poisonous root and seeds of *Colchicum officinale* of Europe as a cathartic, emetic, and sedative; and *Helonias bullata* of North America as a vermifuge. The roots of Gloriosa, also, are poisonous. *Dracæna Draco*, the dragon tree of the Canaries and Teneriffe, famous for the extreme age and size of the trees, was superstitiously revered by the ancients. The red resinous astringent exudation of these plants was called dragon's blood.

The following have been used for food: Bulbs of *Camassia esculenta*, western United States; bulbs and

leaves of Allium sp. (onion, leek, eschalot or shallot, rochambole); shoots of Polygonatum, Europe, United States; shoots of *Asparagus officinalis;* roots of Cordyline sp., in South Sea Islands, and there called ti. The seeds of Ruscus are a substitute for coffee.

A few have been used for other purposes: Roots of Yucca for soap; fibers of New Zealand flax (*Phormium tenax*) for fabrics; and the fragrant root of *Dianella nemorosa* for incense.

For ornament, great numbers of genera and species are in cultivation.

Very many genera are in cultivation, some common, for ornamental purposes unless otherwise stated. Among these are Agapanthus (African Lily, Lily-of-the-Nile); Aletris (Colic Root), native; Allium (Onion, Chives, Cives, Garlic, Leek, Shallot), ornament and food; Asphodeline (True Asphodel, King's Spear); Asphodelus (Branching Asphodel); Bessera (Mexican Coral Drops); Brevoortia (Floral Fire-Cracker); Brodiæa; Calochortus (Star Tulip, Globe Flower, Mariposa Lily, Butterfly Tulip); Camassia (Camass); Chionodoxa (Glory-of-the-Snow); Chlorogalum (Soap Plant, Amole); Clintonia, native; Colchicum (Meadow Saffron, Autumn Crocus); Cordyline (Dracæna); Dasylirion; Dracæna (Dragon Tree); Erythronium (Dog's-tooth Violet, Adder's Tongue); Eucomis (Royal Crown, Pineapple Flower); Fritillaria (Crown Imperial, Black Lily, Checkered Lily); Funkia (Day Lily, Plantain Lily); Galtonia (Giant Summer Hyacinth); Gasteria; Gloriosa (Climbing Lily); Haworthia; Helonias (Swamp Pink, Stud Pink); Hemerocallis (Yellow Day Lily, Lemon Lily); Hyacinthus (Hyacinth); Kniphofia (Red-hot-poker Plant, Torch Lily, Flame Flower); Lachenalia (Cape Cowslip); Lapageria (Chilean Bellflower); Leucocrinum (Sand Lily); Lilium (Lily, Easter Lily, Madonna Lily, Tiger Lily, Japan Lily, Turk's-cap Lily); Littonia (Climbing Lily); Maianthemum (False Lily-of-the-Valley, Two-leaved False Solomon's Seal), native; Medeola (Indian Cucumber Root), native; Melanthium (Bunch Flower); Milla (Mexican Star, Mexican Star of Bethlehem, Frost Flower, Floating Star); Muscari (Grape Hyacinth, Musk Hyacinth, Feathered Hyacinth); Narthecium (Bog Asphodel); Nolina; Nothoscordum (Yellow False Garlic, Streaked-leaved Garlic); Oakesia (Wild Oats), native; Ornithogalum (Star of Bethlehem); Paradisea (St. Bruno's Lily, St. Bernard's Lily); Paris (Herb Paris, Love Apple, True Love); Phormium (New Zealand Flax); Polygonatum (Solomon's Seal); Ruscus (Butcher's Broom); Sansevieria (Bow-string Hemp); Scilla (Squill, Wild Hyacinth, Bluebell, Harebell, Spanish Jacinth, Sea Onion, Starry Hyacinth, Cuban Lily, Hyacinth of Peru, Peruvian Jacinth); Semele (Climbing Butcher's Broom); Smilacina (False Solomon's Seal), native; Smilax; Streptopus (Twisted Stalk), native; Tricyrtis (Toad Lily); Trillium (Wake-Robin, Birthroot, Bethroot, White Wood Lily, Ground Lily), native; Triteleia (Spring Star-Flower); Tulipa (Tulip); Urginea (Sea Onion, Squills); Uvularia (Bellwort, Wild Oats), native; Veratrum (False Hellebore, White Hellebore, Green Hellebore, Black Hellebore, Indian Poke); Xanthorrhœa (Grass Tree, Grass Gum, Black Boy); Xerophyllum (Turkey's Beard); Yucca (Spanish Bayonet, Adam's Needle, Bear Grass, Silk Grass); Zygadenus (Fly-poison).

38. **Amaryllidaceæ** (from the genus *Amaryllis* named for a nymph celebrated by Virgil). AMARYLLIS FAMILY. Fig. 11. Caulescent or acaulescent herbs, bulbous- or fibrous-rooted: leaves alternate, elongated, entire: flowers bisexual, regular or irregular, epigynous, usually borne singly or in clusters from a spathe-like bract; perianth of 6 similar parts in 2 series, usually connate below into a tube and sometimes with a tubular or cup-shaped crown in the throat; stamens 6, some occasionally staminodial; anthers introrse; ovary inferior, 3-celled; ovules numerous, anatropous; style 1; stigmas 1–3: fruit a capsule, rarely a berry; seeds albuminous.

There are 71 genera and about 800 species, widely distributed but most abundant in the steppe regions of the tropics and subtropics. Five species are found in the northeastern United States. The largest genera are Crinum with 60 species, and Hypoxis, and Hippeastrum with 50 species each. The family is most closely related to the Liliaceæ; less closely to the Iridaceæ. The 6-parted perianth, 6 stamens with introrse anthers, and inferior 3-celled ovary, are together distinctive.

The bulbs or rootstocks of some species have been used in medicine. Those of *Narcissus Pseudo-Narcissus* and *Leucoium vernum* are vigorous emetics. Those of *Crinum zeylanicum* of the Moluccas, *Amaryllis Belladonna,* of the Cape of Good Hope, and *Buphane toxicaria* of South Africa are violent poisons. The latter is used by the Kafirs to poison their arrows. In South America the farinaceous tubers of the Alstrœmeriæ are eaten. The most important plants are the Yuccas. From the terminal bud of these, a sugary liquid is obtained which by the Mexicans is made into a fermented drink, called pulque; when distilled this drink is called mescal. The juice of the leaves has been used for syphilis, scrofula, and cancers. The leaf-fibers yield vegetable silk or sisal hemp, and are also made into paper. Razor-strops and cork are made from the pith. The flowers are sometimes boiled and eaten.

Forty or more genera are in cultivation in America, as ornamental plants in greenhouse and garden. Among these are: Agave (Century Plant, Sisal Hemp, Pulque Plant); Alstrœmeria; Amaryllis (Belladonna Lily); Beschorneria; Bomarea; Bravoa (Mexican Twin Flower); Cooperia (Evening Star, Giant Fairy Lily); Crinum (St. John's Lily, Florida Swamp Lily); Eucharis (Amazon Lily, Star of Bethlehem); Eurycles (Brisbane Lily); Furcræa; Galanthus (Snowdrop); Griffinia (Blue Amaryllis); Hæmanthus (Blood Lily); Hippeastrum (Amaryllis, Lily-of-the-Palace, Barbadoes Lily); Hymenocallis (Spider Lily, Sea Daffodil); Hypoxis (Star Grass), native; Leucoium (Snowflake); Lycoris (Golden Spider Lily); Narcissus (Narcissus, Jonquil, Daffodil, Pheasant's Eye); Nerine (Guernsey Lily); Pancratium (Spider Lily, Spirit Lily); Polianthes (Tuberose); Sprekelia (Jacobæan Lily); Tecophilæa (Chilean Crocus); Vallota (Scarborough Lily); Zephyranthes (Zephyr Flower, Fairy Lily, Atamasco Lily).

39. **Taccaceæ** (from the genus *Tacca,* from the Malay name). TACCA FAMILY. Fig. 12. Herbaceous plants: leaves large, entire, or commonly pinnatifid or bipinnatifid, all basal: flowers saucer- or urn-shaped, bisexual, regular, epigynous; perianth of 6 nearly separate similar parts in 2 series; stamens 6, borne on the base of the perianth; filaments queerly broadened and cucullate; ovary inferior, 1-celled, or incompletely 3-celled; ovules numerous; placentæ parietal; style umbrella-like, the terminal disk variously lobed, and bearing the peculiar stigmatic pores beneath: fruit a capsule or berry; seed albuminous.

Taccaceæ has 2 genera and 10 species, inhabitants of the tropics of both hemispheres, mostly of the Malay archipelago. A very distinct family of doubtful relationship, even suggesting several Dicotyledonous families, but probably close to the Dioscoriaceæ and Amaryllidaceæ. The acaulescent habit, the epigynous bisexual flowers, the six queer stamens, and the 1-celled, many-ovuled ovary, are together distinctive.

Several species of Tacca, e. g., *T. pinnatifida,* possess tubers from which a starchy meal, called arrowroot, is made in the East. Straw hats are made from the stems of Tacca by the Tahitians.

Tacca pinnatifida and *T. cristata* are cultivated sparingly in America.

40. **Dioscoreaceæ** (from the genus *Dioscorea,* named in honor of Dioscorides). YAM FAMILY. Fig. 12. Climbing or twining herbs or shrubs: leaves alternate, mostly arrowhead-shaped: flowers bisexual or unisex-

ual, regular, small, and inconspicuous; perianth of 6 similar parts, in 2 series; stamens usually 6, or the 3 inner staminodia; ovary inferior, 3-celled, rarely 1-celled; placentæ axile or parietal; ovules 2 in each cell, superposed, anatropous; stigmas 3, or each 2-parted: fruit a capsule or berry; seed albuminous.

Nine genera and about 170 species, of which 150 belong to the genus Dioscorea, are distributed very generally in the tropics and in the subtropics, and extend sparingly into the north temperate zone. They are most abundant in South America and the West Indies. One species reaches north to southern New England. The family is related to the Amaryllidaceæ and Liliaceæ. The climbing habit, peculiar leaves, definite stamens, inferior 3-celled ovary, and 2 albuminous seeds are distinctive. Most Dioscoriaceæ spring from a tuberous base, which is sometimes very large and conspicuous. Odd tubers are borne in the leaf-axils of species of Dioscorea and Rajania.

The tuberous root of *Dioscorea Batatas* yields the yams of eastern commerce, a very important article of food in the Far East. Those of several other species, including our own native *D. villosa*, are also cultivated in various parts of the tropics. The leaves of some species are used in intermittent fevers. The tubers of *Tamus communis* were formerly employed as a purgative, and were also applied to bruises, hence the name "beaten woman's herb." The shoots are eaten like asparagus.

Two genera are in cultivation in the United States, mostly in the South: Dioscorea (Yam, Chinese Potato, Cinnamon Vine, Air Potato); Testudinaria (Hottentot's Bread, Tortoise Plant, Elephant's Foot), rarely grown.

41. **Iridaceæ** (from the genus *Iris*, the rainbow). IRIS FAMILY. Fig. 12. Herbs or sub-shrubs with fibrous roots or often tuberous rootstocks (corms): leaves mostly basal, equitant, linear: flowers usually showy, bisexual, regular or irregular, epigynous, each with 2 spathe-like bracts; perianth of 6 petaloid parts in 2 series, usually unlike, generally connate into a tube; stamens 3, the inner whorl wanting, separate or connate; anthers extrorse; ovary inferior, 3-celled, rarely 1-celled; ovules few to many, anatropous; style 1; stigmas 3: fruit a capsule; seeds albuminous.

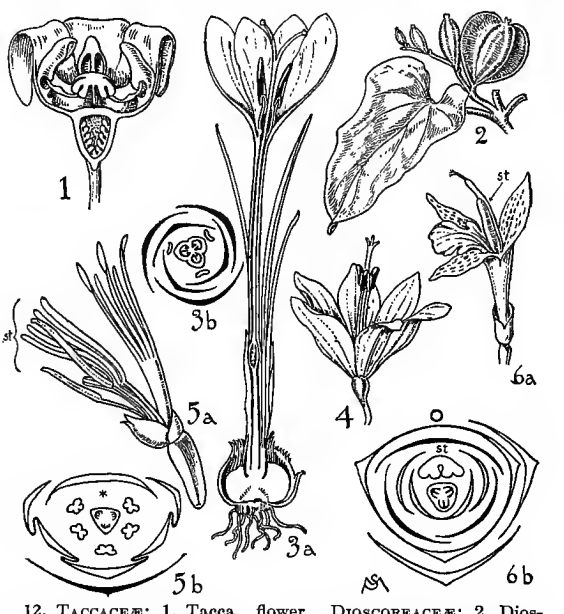
The iris family has 57 genera and about 1,000 species of wide distribution. The two main centers are the Cape of Good Hope and subtropical America. The family is not plainly related to any other, perhaps most closely to the Amaryllidaceæ. The ensiform equitant leaves, the 6-parted showy perianth, the 3 extrorse stamens, and the inferior 3-celled ovary, are together characteristic.

The rootstocks of many Iridaceæ are purgative and diuretic, e. g., *Iris florentina*, *I. germanica*, *I. pallida*, and *I. versicolor*. The rootstock of *I. florentina* is fragrant and used for sachet perfume and tooth-powder (orris root). *I. Pseudacorus* and *I. versicolor* have been used for dropsy and diarrhea. *I. fœtidissima* was an ancient remedy for scrofula and hysteria. The stigmas of *Crocus sativus* have been renowned since earliest times as an emmenagogue; they are deep orange in color, and used also in dyeing and as a condiment. Iris-green of the painters was prepared by treating violet iris flowers with lime. The seeds of *I. Pseudacorus* have been used as a substitute for coffee. The rootstocks of *Homeria collina* of South Africa are very poisonous. The family contains many well-known ornamental plants.

In America, many genera are in cultivation, all for ornamental purposes. Among these are: Belamcanda (Blackberry Lily, Leopold Flower); Crocus; Freesia; Gladiolus; Hermodactylus (Snake's-head Iris); Iris (Fleur-de-lis, Iris, Gladwin); Ixia; Moræa (Wedding Iris); Schizostylis (Crimson Flag); Sisyrinchium (Blue-eyed Grass, Satin Flower, Rush Lily); Sparaxis (Wand Flower); Tigridia (Tiger Flower, Shell Flower); Tritonia (Blazing Star).

Order 20. SCITAMINEÆ

42. **Musaceæ** (from the genus *Musa*, the Arabic name). BANANA FAMILY. Fig. 12. Large, semi-ligneous herbs, the stout stem enveloped at base by the sheathing petioles, unbranched: leaves alternate, entire, convolute, pinnately parallel-veined: flowers bisexual, or unisexual, irregular, epigynous, borne in the axil of a bract in spikes with subtending spathes; nectaries ovarian; perianth of 6 parts, in 2 series, the parts unequal in size and shape, separate or variously united; stamens 6, 5 fertile and 1 staminodium; ovary inferior, 3-celled; ovules solitary and basal, or numerous and axile, anatropous; style 1; stigmas usually 3: fruit



12. TACCACEÆ: 1. Tacca, flower. DIOSCOREACEÆ: 2. Dioscorea, leaf and fruit. IRIDACEÆ: 3. Crocus, *a*, vertical section whole plant; *b*, floral diagram. 4. Sisyrinchium, flower. MUSACEÆ: 5. Musa; *a*, flower, *st.*, stamen; *b*, floral diagram. ZINGIBERACEÆ: 6. Zingiber, *a*, flower; *st.*, stamen; *b*, floral diagram.

fleshy and pulpy or drupaceous, indehiscent, dehiscent or separating into fruitlets; seeds with perisperm; embryo straight.

Six genera and about 60 species occur, 30 of which belong to the genus Heliconia and 20 to Musa, of general tropical distribution. Fossil species are known. The family is related to the Marantaceæ, Zingiberaceæ and Cannaceæ; with the last it is often united. These families all have irregular flowers of the same type, and inferior ovaries; but the Musaceæ differ in their slightly differentiated calyx and corolla, in the 5 fertile stamens, and in the absence of aromatic principles.

The banana (*Musa paradisiaca*, *M. sapientum*, etc.) is the most important economic plant, the fruit of which is widely used for food. The pith of the stem, top of the floral spike, and also the shoots, are eaten as vegetables. The fibers from the petioles of *Musa textilis* are made into thread and fabrics. The leaves are used to thatch huts. The traveler's tree (*Ravenala madagascariensis*) holds sufficient water at the leaf bases to serve for drink. The water is obtained by boring the sheath. The seeds of this tree are eaten.

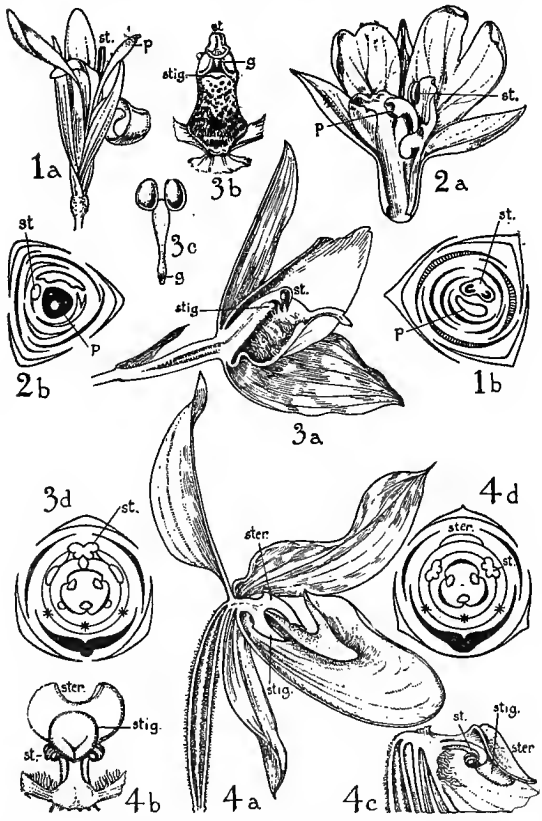
Four genera are in cultivation in the South and in conservatories, for ornament; and one also, Musa, for the fruit: Heliconia (Balisier, Wild Plantain); Musa (Banana, Plantain Tree, Chumpa, Adam's Fig); Ravenala (Traveler's Tree); Strelitzia (Bird of Paradise Flower).

43. **Zingiberaceæ** (from the genus *Zingiber*, the Indian

name). GINGER FAMILY. Fig. 12. Herbs with creeping or tuberous rhizomes, rarely with fibrous roots: leaves basal or cauline, alternate, sheathing; blade with ligule at top of petiole, linear or elliptic, the pinnately parallel veins strongly ascending: flowers bisexual, irregular, epigynous; perianth of 6 parts, in 2 series, differentiated into a tubular 3-toothed or spathiform somewhat herbaceous calyx, and a tubular unequally 3-lobed corolla; 1 stamen only is fertile, opposite this is a large petaloid staminodium, and there are sometimes other smaller ones; ovary inferior, 3-celled, rarely 1-celled; ovules many in each cell; style 1; stigma usually 1: fruit a capsule; seed with large perisperm, small endosperm, and straight embryo.

There are 24 genera and about 270 species, distributed in the tropical regions of the eastern hemisphere. Only 2 genera are in America. The largest genera are Amomum, with 50 species, and Alpinia, with 40 species. The family is related to the Musaceæ, Marantaceæ and Cannaceæ, but differs in the ligule, the aromatic oil, the sharp differentiation of the perianth, the single stamen, and the large single staminodium.

To the spicy aromatic flavor of the rhizomes and fruits the family owes its useful qualities. Ginger is from the rhizomes of *Zingiber officinale*, cultivated from India. Cardamon fruits are from *Elettaria Cardamomum* of farther India. Curcuma or turmeric is from the rhizomes of *Curcuma longa*, cultivated from southeast Asia. This is used in medicine, and for flavoring pickles. In it is a yellow dye. The seeds of *Amomum Melegueta* of west Africa are the grains of paradise of commerce. Galangal, used in perfumery, is the rootstock of *Alpinia Galanga* of the East Indies.



13. CANNACEÆ: 1. Canna, *a*, flower; *b*, floral diagram. MARANTACEÆ: 2. Maranta, *a*, flower, pistil removed; *b*, floral diagram. ORCHIDACEÆ: 3. Lycaste, *a*, flower; *b*, column, front view; *c*, pollinia and gland; *d*, floral diagram. 4. Cypripedium, *a*, flower; *b*, column, under side; *c*, column, side view; *d*, floral diagram. (*st.*, fertile stamen; *ster.*, sterile stamen; *stig.*, stigma; *g*, gland; *p.*, pistil).

Several genera are in cultivation in America, mostly grown for ornamental purposes in greenhouses and principally in the South. Among these are: Alpinia (Shell Flower); Amomum; Curcuma (Curcuma, Turmeric); Elettaria (commercial Cardamon seeds); Hedychium (Butterfly Lily, Ginger Lily, Garland Lily); Kæmpferia; Zingiber (Ginger).

44. **Cannaceæ** (from the genus *Canna*, the origin of the name not clear). CANNA FAMILY. Fig. 13. Similar to the Marantaceæ in all but the following structural details: no joint nor ligule at summit of petiole; ovules many in each cell of the ovary; embryo straight.

This family contains a single genus and 25–50 species of tropical and subtropical America.

The starchy rhizome of *C. edulis* is grown and eaten in the West Indies and Australia. The arrowroot starch of the English and French is derived from *C. coccinea* of the West Indies and South America. The cannas are popular ornamental garden plants.

45. **Marantaceæ** (from the genus *Maranta*, named for Maranti, a Venetian botanist and physician of the 16th century). ARROWROOT FAMILY. Fig. 13. Herbs with rhizomes: leaves mostly basal, with an articulation at the summit of the petiole; blade linear to oval, pinnately parallel-veined: inflorescence usually surrounded by spathe-like bracts; flowers bisexual, irregular, epigynous; perianth of 6 parts, plainly differentiated into calyx and corolla, the latter somewhat irregular; one stamen of the inner set fertile, petaloid, with lateral anther, the two others of the inner whorl transformed into enlarged staminodia; usually 1 or 2 of the outer whorl also present as petaloid staminodia; ovary inferior, 3-celled, rarely 1–2-celled; ovule 1 in each cell; style flat and twisted or lobed: fruit a capsule or berry; seeds with perisperm, and aril; embryo curved.

Marantaceæ has 12 genera and about 160 species, of damp situations in the tropics, mostly American. The largest genus is Calathea with 60 species. The family is related to the Cannaceæ, Zingiberaceæ, and Musaceæ. The joint at the summit of the petiole, the type of stamen-irregularity, the 1-seeded cells of the ovary, and the curved embryo are distinctive.

The rhizome of *Maranta arundinacea* is cultivated in tropical America, and furnishes the maranta arrowroot of commerce; rhizomes of some other species are eaten. Many species are ornamental, mostly for conservatory.

Five or 6 genera are in cultivation in America, as Calathea (Rattlesnake Plant); Maranta; Phrynium; Stromanthe; Thalia.

Order 21. MICROSPERMÆ

46. **Orchidaceæ** (from the genus *Orchis*, an ancient name of these plants). ORCHID FAMILY. Fig. 13. Herbaceous plants of very diverse habit and structure; terrestrial, epiphytic or saprophytic, sometimes climbing; the terrestrial with fibrous roots or with thickened tuber-like roots, the epiphytic often with the base of the leaf and adjoining stem swollen, forming a pseudobulb; the saprophytic without chlorophyll; the epiphytic often with aërial hanging roots are provided with a water-absorbing layer (velamen): leaves alternate, succulent, coriaceous or membranous, linear to oval: flowers bisexual, rarely unisexual, irregular, epigynous; perianth of 6 parts, in 2 series, usually all petaloid; one petal larger, forming the lip (labellum); stamens originally 6, but all except 1 or 2 wanting, or reduced to staminodia, united with the pistil; pollen-grains compound, granular, or aggregated into masses (pollinia) which are either free in the anther or attached by a stalk to a viscid apical or stigmatic gland; carpels 3; ovary inferior, 1- or 3-celled; ovules very numerous; style united with the stamens to form the column; stigma in the front of the column, or on a projecting lobe: fruit a capsule; seeds very minute.

This is an important family of more than 400 genera and between 6,000 and 10,000 species. Orchids are very widely distributed, except in the arctics, but are most numerous in the tropics. Those of temperate regions are mainly terrestrial; those in the tropics commonly epiphytic. The large genera are Epidendrum, 500 species; Habenaria, Dendrobium, Bulbophyllum, and Oncidium, 200–600 species each; Masdevallia, Odontoglossum, and Maxillaria, each 100 or more species.

From the standpoint of the intricate and very special mechanisms evolved in order to insure cross-pollination, the orchids are the most wonderful of our insect-pollinated plants. For a detailed account see Darwin's "Fertilization of Orchids," or Kerner and Oliver's "Natural History of Plants." In general, the insect visiting the showy flower for the honey comes in contact with the sticky gland above the stigma, thereby pulling it out, along with the attached pollen masses. While the insect is going to another flower, the pollen masses dry and bend down until they are in position to strike the viscid stigma, which tears away and retains some of the pollen. The method of pollination in Cypripedium is fundamentally different. Some orchids (e.g., Catasetum) possess a sensitive explosive mechanism that forcibly ejects the pollen mass, often to the distance of 2 or 3 feet. The minute seeds of the orchids are well adapted to be disseminated by the wind and find lodgment in the crevices of the bark of trees and on other supports.

Orchids are divided into large groups as follows:

Group I. Diandræ. The two lateral stamens of the inner whorl fertile, the dorsal of the outer whorl staminodial or fruitful, the others absent. Cypripedium, Selenipedium, Paphiopedilum, and others.

Group II. Monandræ. The dorsal stamen of the outer whorl fruitful, all the others wanting. By far the majority of the species belong here. Subgroup I. Pollinia connected by caudicles with a gland at base of anther near stigma. Subgroup 2. Pollen without caudicles or with these attached to a gland at apex of anther.

The family is very distinct and easily distinguished. Its only near relatives are the Burmanniaceæ. The peculiar structure of the stamens and pistil, together with the minute exalbuminous seeds are distinctive.

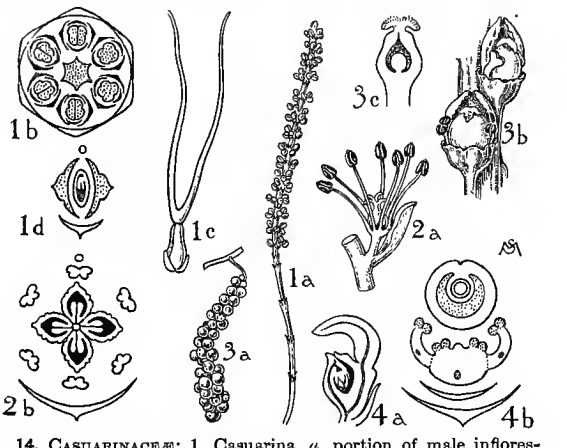
The Orchidaceæ is perhaps the most important family from the standpoint of ornamental gardening. To grow these singular, fantastic, showy, and often sweet-scented flowers has in recent years become almost a craze. It is estimated that, whereas Linnæus knew but a dozen exotic orchids, at the present day more than 2,500 are known to English horticulturists. Plants in the family useful for other purposes are few. The most important is vanilla, derived from the capsule of *Vanilla planifolia* of Mexico, and now widely cultivated in the tropics. Faham (*Angræcum fragrans* of Bourbon) has a fragrant, bitter-almond-like taste; the leaves are used for indigestion and tuberculosis, and are known as Bourbon tea. Salep is derived from the roots of various terrestrial orchids of the Mediterranean region. The roots of helleborine (*Epipactis latifolia*) are used for rheumatism. The root of *Spiranthes diuretica* of Chile is renowned as a diuretic. The flowers of *Habenaria conopsea* are used for dysentery. *Spiranthes autumnalis* and *Habenaria bifolia* are said to be aphrodisiac. The roots of *Cypripedium parviflorum* var. *pubescens* are frequently used in America as a substitute for valerian.

CLASS II. DICOTYLEDONEÆ

Sub-class 1. Archichlamydeæ (Choripetalæ and Apetalæ)

Order 22. Verticillales

47. **Casuarinaceæ** (from the genus *Casuarina*, derived from the resemblance of the branches to the feathers of the bird cassowary). Casuarina Family. Fig. 14. Shrubs, or much-branched trees, with the habit of the horse-tail (Equisetum) or Ephedra: branches whorled, jointed, striate: leaves replaced by striate, many-toothed sheaths: flowers monœcious or dicœcious, the staminate in spikes, the pistillate in heads; perianth of the staminate flower of 2, rarely 1, bract-like parts; stamen 1; perianth of the pistillate flower 0; ovary 1-celled, rarely 2-celled, 2–4-ovuled; stigmas 2: fruit



14. Casuarinaceæ: 1. Casuarina, *a*, portion of male inflorescence; *b*, diagram of whorl of flowers; *c*, female flower; *d*, female flower, cross-section. Saururaceæ: 2. Saururus, *a*, flower; *b*, floral diagram. Piperaceæ: 3. Piper, *a*, inflorescence in fruit; *b*, portion of spike with flowers; *c*, female flower, vertical section. Chloranthaceæ: 4. Chloranthus, *a*, flower, vertical section; *b*, floral diagram.

dry, often samaroid, inclosed by the woody valve-like bracts; seeds 2, or 3–4, orthotropous, ascending.

A single genus containing about 20 species occurs in Australia and the neighboring islands, extending to Madagascar and to southeast Asia. The family is very distinct and its relationships are in doubt. It is placed here in the system because of the simple flowers. The peculiar habit, reduced staminate flowers, and peculiar fruit are characteristic.

The wood of *Casuarina equisetifolia* is very hard, and called ironwood. It is used in ship-building, and by the Indians for war-clubs; the powdered bark is used to dress wounds, or for diarrhea. A brown dye is obtained from the same plant.

A few species of Casuarina (Beefwood, She Oak) are cultivated in the South for timber and ornament.

Order 23. Piperales

48. **Saururaceæ** (from the genus *Saururus*, meaning *lizard's tail*, in allusion to the long slender spike). Lizard's-Tail Family. Fig. 14. Herbs: leaves alternate, large and broad: flowers bisexual, regular, in a long, dense spike; perianth 0; stamens 6 or fewer, hypogynous or united with the pistil; carpels 3–4, separate, or united in to a 3–4-celled ovary; ovules 2 to several, parietal; stigmas as many as the carpels: fruit of follicles, or a lobed berry.

Three genera and about 4 species are found in temperate or subtropical Asia and North America. The family is related to the Piperaceæ, with which it is frequently united. From that family it differs in having several carpels in each flower and several parietal ovules for each carpel.

Saururus cernuus (lizard's tail), a native herb, is in the trade as a garden plant for wet soil.

49. **Piperaceæ** (from the genus *Piper*, an ancient name of pepper). Pepper Family. Fig. 14. Herbs, shrubs, or rarely trees: leaves alternate, rarely opposite or whorled: flowers in dense spikes, bisexual, or unisexual, regular; perianth 0; stamens 1–10; ovary

1-celled; ovule 1, basal; stigmas 1–4, rarely more, sessile: fruit a dry or fleshy berry.

There are 9 genera and about 1,025 species, confined to the tropics. The largest genera are Piper with 600 species and Peperomia with 400 species. The family is related to the Saururaceæ, with which it is often united; otherwise it stands alone as a distinct type, the systematic position of which is uncertain. The spicate inflorescence, naked flowers, and 1-celled, 1-seeded ovary are distinctive.

The unripe fruit of *Piper nigrum* (Java, etc.) yields black pepper. The ripe fruit of the same plant yields white pepper. Long pepper is the whole spike of *P. longum* of India. The drug cubebs is obtained from *P. Cubeba*. Betel consists of the leaves of *P. Betle*, which in India are mixed with the areca nut and masticated (p. 16). From an extraction of the roots of *P. methysticum* (ava, or kava-kava), mixed with the milk of coconuts, an intoxicating drink is made in the Pacific Islands. Some species of Peperomia are eaten as salads; others chewed as betel.

Some genera are in cultivation in America as greenhouse foliage plants: Peperomia, 10 or more species; Piper (Pepper, Black Pepper, Japanese Pepper).

50. **Chloranthaceæ** (from the genus *Chloranthus*, signifying *green flowers*). Chloranthus Family. Fig. 14. Herbs, shrubs or trees: leaves opposite: flowers bisexual or unisexual, regular, very small, subtended by bracts, and mostly borne in spikes; perianth 0; stamens in the bisexual flowers 1–3, united with each other and with the ovary; in the staminate inflorescence inserted on a common axis and forming a spike; carpels 1, with 1 pendent ovule; stigma sessile: fruit drupaceous.

Three genera and about 35 species occur, in tropical America, East Asia, and the islands of the Pacific Ocean. The family is related to the Piperaceæ and Saururaceæ. The opposite leaves, the few stamens, which are often unilaterally united with the 1-celled ovary, and the suspended ovule, are peculiar.

The roots of *Chloranthus officinalis* have a camphor-like odor, and are used in the East as a febrifuge.

One species of Chloranthus is grown in greenhouses for foliage and berries.

Order 24. Salicales

51. **Salicaceæ** (from the genus *Salix*, the classical Latin name). Willow Family. Fig. 15. Shrubs or trees, creeping in the arctics: leaves alternate, simple: flowers dicœcious, both sexes in catkins, 1 flower to each scale; perianth 0; disk present, cup-shaped or finger-like; stamens 2–many, separate or united; ovary often pedicelled, 1-celled; placentæ 2, parietal; ovules numerous; stigmas 2, often each 2-lobed: fruit a capsule; seeds with a basal tuft of long hairs.

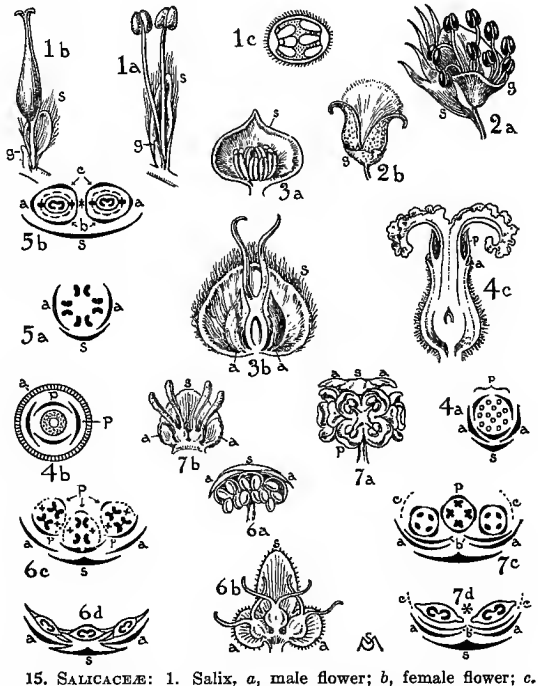
Salicaceæ has 2 genera and about 180 species, of which 160 belong to the genus Salix; inhabitants of the north temperate and arctic zones, a few in the tropics and in South Africa. The family is not definitely related to any other family, though possibly to the Tamaricaceæ. The flowers of both sexes in catkins, the glandular disk, and the dehiscent many-seeded capsule with comose seeds, are distinctive.

The bark of many species has been used for intermittent fevers and for tanning leather. A yellow dye occurs in the bark of *Populus alba* and *P. tremula*, also in *Salix alba*, *S. daphnoides*, and others. The resinous buds of *P. balsamifera*, or tacamahac, furnish American balm of Gilead. The staminate catkins of *S. ægyptiaca* are odoriferous and are used in the East in medicinal waters, as a cordial, and as a sudorific. Willow and poplar wood is soft and light. The twigs of several species of Salix are universally used in basket-making.

The two genera are in cultivation in America, as ornamental plants and for shelter-belts and basket-work and sometimes for timber: Populus (Poplar, Aspen, Tacamahac, Balm of Gilead [not the original], Cottonwood, Abele); and Salix (Willow, Osier).

Order 25. Myricales

52. **Myricaceæ** (from the genus *Myrica*, the ancient name of the Tamarisk). Sweet Gale Family. Fig. 15. Shrubs or trees: leaves alternate, usually simple, resinous: flowers monœcious or dicœcious, in catkins or spikes, single for each bract; perianth 0; stamens 4–6, or 16, in the axil of the bract (scale); ovary 1-celled, 1-ovuled; stigmas 2: fruit a drupe, usually slightly horned by union with the bracteoles; seed solitary, orthotropous, basal.



15. Salicaceæ: 1. Salix, *a*, male flower; *b*, female flower; *c*, cross-section ovary. 2. Populus, *a*, male flower; *b*, dehiscing fruit. Myricaceæ: 3. Myrica, *a*, male flower; *b*, female flower. Juglandaceæ: 4. Juglans, *a*, diagram male flower; *b*, diagram female flower; *c*, vertical section female flower. Betulaceæ: 5. Corylus, *a*, diagram male flower; *b*, diagram female flowers. 6. Betula, *a*, male flowers; *b*, female flowers; *c*, diagram male flowers; *d*, diagram female flowers. 7. Alnus, *a*, male flowers; *b*, female flowers; *c*, diagram male flowers; *d*, diagram female flowers. (*s*, scale; *a*, *b*, and *c*, bractioles of the first, second and third orders; *p*, perianth; *g*, gland.)

One genus with about 35 species is generally distributed over the more temperate parts of the earth. The Myricaceæ are related to the other amentiferous families, e.g., Juglandaceæ, Fagaceæ and Betulaceæ. The indehiscent, 1-seeded fruit, basal seeds, two carpels, absence of perianth, and simple leaves are characteristic of the family.

Myrica Gale and other species are used for tanning leather. *M. Gale* has also been used in the preparation of beer. The wax from the drupelets of *M. cerifera* and *M. carolinensis* is used for making candles. The fruit of *M. sapida* and *M. Nagi* is edible. *M.* (*Comptonia*) *asplenifolia* has been used as a tonic. A volatile oil is obtained from the fruits of *M. Gale*. The root of *M. cerifera* is emetic and purgative.

M. Nagi is cultivated in California for the edible fruit. *M. asplenifolia*, native in the United States, is grown for ornament. Other species are sometimes planted.

Order 26. Juglandales

53. **Juglandaceæ** (from the genus *Juglans*, a contraction of the Latin *Jovis glans*, the nut of Jupiter). Walnut Family. Fig. 15. Trees or shrubs, often resinous: leaves alternate, exstipulate, pinnately compound: flowers monœcious, small; the staminate in drooping catkins with single perianth of 4 parts, or rarely 0, one flower for each bract; the pistillate 2–3 together, with perianth of 4 parts adherent to the ovary as are also the bract and bracteole; ovary inferior, 1-celled; ovule 1, basal, orthotropous; stigmas usually 2- or 4-branched: fruit a nut with a fleshy exocarp, or bursting irregularly, or 4-valved, or winged.

In this family are 6 genera and about 35 species of the north temperate zone. The largest genus is Carya with 10 species. The family is related to other Amentiferæ, e.g., Myricaceæ, Fagaceæ, and Betulaceæ. The indehiscent, 1-seeded fruit, basal seeds, 2 carpels, perianth and pinnate leaves are distinctive. Fossil species are known.

The wood of English walnut is highly valued, but that of *Juglans nigra* (black walnut) is one of the most valuable of woods. Hickory wood is prized for its hardness and toughness. The fruits of the English walnut (*J. regia*), butternut (*J. cinerea*), and of species of Carya (hickory) are among the most important food-nuts. The leaves and bark of Carya and Juglans are purgative. Green dyes are obtained from *Carya tomentosa*, and yellow from *C. ovata*, *C. sulcata*, and *C. glabra*. Walnut oil and hickory oil are in the trade.

The cultivated genera in America are Carya or Hicoria (Hickory, Pecan, Bitternut, Pignut, Mockernut, Shellbark, Kingnut), native and hardy; Juglans (Walnut, Butternut, English Walnut), ornamental, fruit, and timber; Platycarya, ornamental; Pterocarya, ornamental.

Order 27. Fagales

54. **Betulaceæ** (from the genus *Betula*, the ancient Latin name of the birch). Birch Family. Fig. 15. Trees or shrubs: leaves alternate, simple, mostly pinnately parallel-veined: flowers monœcious, regular, much reduced; the staminate in slender catkins; the pistillate in short spikes, rarely in flexuous catkins or geminate; 3 flowers, rarely by reduction 2 or 1 flower behind each bract; perianth of the staminate flower single, 2–4-lobed or 0; stamens 2–10; perianth of the pistillate flower absent in Betula and Alnus, in other genera an epigynous crown of several tiny scales; ovary inferior, originally 2-celled and each cell 1-ovuled, but only one cell and 1 seed maturing; stigmas 2: fruit an indehiscent nutlet, often winged; either separating from the bract and bracteoles (Alnus, Betula), or falling with them, in which case these organs form a protective involucre (Corylus), or a winged or bladdery organ concerned in seed-dissemination (Carpinus, Ostrya); seeds anatropous, exalbuminous.

Six genera and about 75 species inhabit the extratropical northern hemisphere; many are arctic, some of which are creeping. Fossil species are known. The family is related to the Fagaceæ and other amentiferous families. The pistillate flowers in spikes, the presence of a perianth in one or the other sex, the cymose group of flowers for each bract, the 2 carpels, and the single integument of the seed are characteristic.

The wood of Alnus and Betula is prized by wagon-makers, cabinet-makers and turners; charcoal for gunpowder is made from this wood. The twigs of Betula are made into brooms. The bark of *Betula papyrifera* strips off in thin plates and is used for making canoes and for writing-paper. The very thin bark-layers of *B. Bhojpattra* of India also furnish writing-paper. Vinegar and beer are made from the sugary sap of Betula, which is also considered an efficient antiscorbutic. The bark of Alnus and Betula is used in tanning Russia leather, and other kinds. Hazelnuts are the fruit of Corylus; filberts of *Corylus Avellana*. Oil of betula has a flavor like wintergreen. The wood of Ostrya is very hard and prized for beetles. The wood of all the Betulaceæ is good for firewood.

Several genera are in cultivation in America for ornament or for the fruit (Corylus) such as: Alnus (Alder); Betula (Birch); Carpinus (Hornbeam Tree, Blue Beech, Water Beech); Corylus (Hazel, Filbert, Cobnut); and Ostrya (Hop Hornbeam, Ironwood, Leverwood).

55. **Fagaceæ** (from the genus *Fagus*, the classical name, in allusion to the esculent nuts). Beech Family. Fig. 16. Trees or shrubs: leaves simple, alternate: flowers monœcious; the staminate in slender catkins, one flower with each bract and a perianth of 4–6 parts; the pistillate solitary or in groups of 3, epigynous, the perianth reduced; ovary mostly 3- or 6-celled; ovules 2 in each cell, suspended, all but one in the ovary aborting; integuments 2; stigmas 3: fruit a 1-seeded nut, which singly, or in a group of 2–3, is surrounded by a special involucre.

The family has 5 genera and about 600 species, all natives of the subtropical and temperate northern hemisphere, except the antarctic genus, Nothofagus. The largest genera are Quercus with 200 species, and Pasania with 100 species. The family is related to the Betulaceæ and other amentiferous families; but the staminate flowers alone in catkins, the indehiscent 1-seeded fruit, the 3 carpels, and the special involucre are distinctive. There has been much debate as to the morphology of the involucre,—whether it is composed of the bracteoles of the little dichasium, or represents sterile scales of the condensed catkin, or is a wholly new outgrowth of the subfloral axis. The latter is a recent view of Engler. This involucre becomes the bur in beech and chestnut, and the cup in the oak.

The wood of white oak, red oak and many other species is very valuable, as is also that of beech and chestnut. The bark of *Quercus Suber* of Spain yields bottle-cork. The bark of *Q. velutina* of America is called quercitron, and is used to dye yellow. The kermes insect, which furnishes a crimson dye, lives on *Q. coccifera* of the Mediterranean. The stings of gall insects produce the commercial oak-galls from which tannic and gallic acid are obtained, and from which ink was made. Officinal creosote is distilled from the tar of species of Fagus. The nut-like fruits of Castanea, Fagus, *Quercus Ilex*, *Q. Robur*, and *Q. Ægilops* are eaten. The cups of *Q. Ægilops* are sold for dyeing black and for tanning. The bark from many species of this family is used for tanbark.

In America several genera are cultivated for ornament, food, and timber: Castanea inc. (Chestnut, Chinquapin); Castanopsis Fagus (Beech); Nothofagus, little known; Quercus (Oak, Black Jack).

Order 28. Urticales

56. **Ulmaceæ** (from the genus *Ulmus*, the classical name). Elm Family. Fig. 16. Trees or shrubs without milky juice: leaves alternate, usually oblique: flowers bisexual or unisexual, regular, small; perianth simple; parts 4–5, rarely 3–7; stamens of the same number opposite the sepals, rarely twice as many, not elastically incurved; ovary superior, 1-celled, 1-ovuled; the ovule suspended, anatropous; stigmas usually 2: fruit nut-like, drupaceous, or winged.

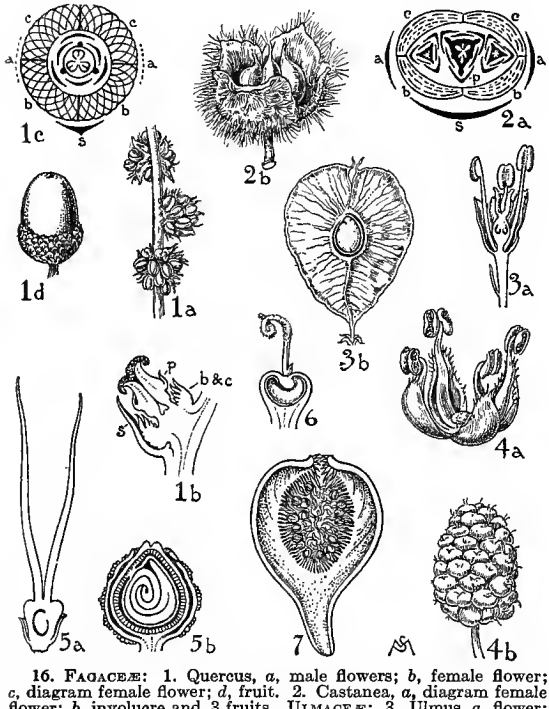
Thirteen genera and about 140 species are generally distributed in all but the polar regions. The largest genus is Celtis, with 60 species. The family is closely related to the Urticaceæ and Moraceæ. Its non-elastic stamens, and suspended anatropous seeds are important distinguishing characters.

The seeds of some species of Celtis are edible. The wood is used to make wind instruments, and the like.

Elm wood is of use in the crafts. The mucilaginous bark of slippery elm (*Ulmus fulva*) is used for poultices and coughs. The fragrant wood of *Planera Abelicea* of Crete is false sandalwood.

There are several genera in cultivation in America. Among these are: Aphananthe, ornamental; Celtis (Nettle Tree, Hackberry, Sugarberry), hardy, ornamental; Planera (Water Elm), ornamental; Ulmus (Elm), ornamental, and for timber; Zelkova, ornamental.

57. **Moraceæ** (from the genus *Morus*, the classical name). MULBERRY FAMILY. Fig. 16. Herbs, shrubs, or trees, sometimes climbing: juice milky: leaves alternate: flowers dicœcious or monœcious, regular, small, mostly in heads or spikes, or lining the hollow pyriform fleshy axis of the inflorescence (Ficus); perianth single, of 4, rarely 2–6, imbricated parts, more or less united and fleshy in the pistillate flower; stamens of the same number and opposite the sepals, usually inflexed in the bud and elastic; ovary superior, sessile or stipitate, 1-celled, 1-ovuled; the ovule suspended, amphitropous, rarely



16. FAGACEÆ: 1. Quercus, *a*, male flowers; *b*, female flower; *c*, diagram female flower; *d*, fruit. 2. Castanea, *a*, diagram female flower; *b*, involucre and 3 fruits. ULMACEÆ: 3. Ulmus, *a*, flower; *b*, fruit. MORACEÆ: 4. Morus, *a*, male flower; *b*, fruit. 5. Humulus, *a*, female flower; *b*, vertical section fruit. 6. Cudrania, pistil. 7. Ficus, vertical section female inflorescence (for explanation of letters see Fig. 15).

basal; stigmas 1–2: fruit an achene or drupe enveloped by the fleshy perianth, or on a fleshy gynophore, or composed of achenes in a fleshy hollow common receptacle.

Moraceæ contains 55 genera and about 950 species, mostly of tropical distribution, 6 species of which are native in the eastern United States. The largest genus is Ficus with 600 species. The family is frequently united with the Urticaceæ and differs from that family only in the presence of milky juice, in the two stigmas, and in the usually suspended seed. From the Ulmaceæ it differs in the inflexed elastic stamens

The fruit of the black mulberry (*Morus nigra*) has been eaten since earliest times. Those of *M. rubra* (red mulberry), and *M. alba* are also used for food. The bread fruit (*Artocarpus incisa*) of the South Sea Islands is now cultivated for food everywhere in the tropics. The leaves of *Morus indica* are eaten in India; those of *M. rubra* in America. *M. serrata* is cultivated for fodder. The fig is the fleshy receptacle of the inflorescence of *Ficus Carica*. For the structure and pollination of this remarkable plant see Kerner and Oliver's "Natural History of Plants." The leaves of Morus are diuretic and anthelmintic. The juice of *Antiaris toxicaria* is used by the Javanese to poison arrows. Hops are used in medicine, also to flavor beer. Hashish, bhang or Cannabis indica is obtained from *Cannabis sativa*, and is much used in the East as a narcotic to chew and smoke like opium. The fibers of *C. sativa* are hemp. The bark of Broussonetia furnishes clothing to the South Sea Islanders. The wood of *Maclura aurantiaca* is flexible; the yellow juice of the fruit of this plant was used by the Indians to paint their faces. *Cudrania javanensis* yields a dye. The milky juice of *Ficus elastica* and other species yield commercial rubber. *F. indica* is a banyan tree of India. *F. religiosa* is the sacred fig. The leaves of various species of mulberry are used to feed silkworms. Shellac is obtained from a small hemipterous insect which lives on *F. laccifera* and *F. religiosa* in India.

Several genera are in cultivation in America, the majority in the far South. Among these are: Artocarpus (Bread Fruit, Jack Fruit), cultivated in the West Indies and in botanical gardens; Brosimum (Bread Nut), tropical; Broussonetia (Paper Mulberry), ornamental, semi-hardy; Cannabis (Hemp), grown for fiber or ornament; Cudrania, grown for hedges; Ficus (Fig, India Rubber Plant, Banyan Tree, Creeping Fig, Peepul Tree), grown in warm regions and in the greenhouses; Humulus (Hops), grown for the fruit; Maclura (Osage Orange), for hedges; Morus (Mulberry), for fruit, and leaves for silkworms.

58. **Urticaceæ** (from the genus *Urtica*, the classical Latin name of the plant, signifying *to burn*). NETTLE FAMILY. Fig. 17. Herbs, shrubs or trees, rarely climbing: leaves alternate or opposite: flowers unisexual, regular; perianth single, rarely 0, usually green, consisting of 4–5, rarely 2–3, separate or united parts, imbricated or valvate; stamens as many, and opposite the segments, inflexed and uncoiling elastically; ovary sessile, or pedicelled, or rarely united with the perianth, 1-celled, 1-ovuled; style 1; stigma feathery: fruit an achene or drupe; seeds basal, orthotropous; embryo straight.

The 41 genera and about 475 species are mainly tropical, a few in North America and fewer in Europe. The largest genus is Pilea, with 100 species. The family is very closely related to the Moraceæ and Ulmaceæ, with which it was formerly united. The apetalous anemophilous flowers, with elastic stamens opposite the sepals, and the 1-celled ovary, with a single basal, orthotropous seed, are distinctive. Many of the Urticaceæ are covered with stinging hairs containing formic acid. The common nettles are examples. Cystoliths are common in the leaves.

Parietaria diffusa and *P. erecta* contain niter, and have been used as diuretics. Nettles were used by doctors to flog patients in order to produce a counter irritation of the skin, a practice called "urtication." Other species have been used locally as medicine. *Laportea stimulans* has been used as a fish-poison. The bast fibers of many species are useful; e.g., *Urtica dioica*, *U. cannabina*, *Laportea canadensis*, and especially the China grass or ramie (*Bœhmeria nivea*). The fibers of this latter have long been used in the Netherlands. The young foliage of many Urticaceæ is used as spinach. The tuberous root of *Pouzolzia tuberosa* is eaten.

The following are in cultivation in America; three of them are ornamental: Pellionia, a greenhouse creeper; Pilea (Artillery Plant), a garden and greenhouse plant; and Urera, a greenhouse shrub. The other genus, Urtica (Nettle), is grown for fiber, and Boehmeria occurs occasionally in cultivation.

Order 29. Proteales

59. **Proteaceæ** (from the genus *Protea*, from Proteus, a self-transforming sea-god, in allusion to the great diversity of the genus). Protea Family. Fig. 17. Shrubs or trees, rarely herbs: leaves alternate: flowers bisexual, rarely unisexual, regular or irregular; perianth of one series, parts 4, separate or variously united, or labiate, valvate; stamens 4, opposite the perianth parts, hypogynous or inserted on the perianth; hypogynous stalk (gynophore) usually developed, often bearing a ring of scales, or swellings, or a cup; carpel 1; ovary superior, 1-celled; ovules 1 to several; style slender; stigma slender or enlarged: fruit unsymmetrical, capsular, drupaceous, or nut-like, or a samara or follicle; seeds sometimes winged.

There are 49 genera and about 1,000 species, mostly Australian, but many also in South Africa, and a few in South America. The largest genera are Grevillea, with 160 species; and Hakea, with 100 species. The family is perhaps distantly related to the Loranthaceæ, Santalaceæ, and Urticaceæ, but the relationship is little understood. The 4 valvate sepals, 4 stamens, and the unsymmetrical, 1-celled ovary, raised on an appendaged gynophore are distinctive. The small flowers are usually aggregated in heads or spikes surrounded by bracts. The Proteaceæ, for the most part, inhabit countries in which a very dry windy season alternates with a rainy season, and many of them are white-hairy.

Grevillea robusta, *Knightia excelsa*, *Embothrium coccineum*, *Leucospermum conocarpum* (redwood), and *Protea grandiflora* (wagen-boom) are useful for timber. The wood of the last species is used for wagon-wheels. The seeds of several species are eaten. A bitter principle is found in *Leucadendron argenteum* of Africa; a gum resin in *Grevillea robusta* of Australia. A golden dye is obtained from the Australian *Persoonia saccata*. *Gevuina avellana* (Chilean hazelnut) furnishes an edible fruit, as does also *Brabeium stellatifolium* (wild chestnut of South Africa), and *Macadamia ternifolia* (Queensland nut). Banksia and Protea furnish important bee-plants.

The genera in cultivation in America are mostly the following: Banksia; Gevuina (Chilean Nut, Chile Hazel), grown in California; Grevillea (Silk Oak), in greenhouse and California; Leucadendron (Silver Tree of the Cape), grown in California; Macadamia (Australian Nut), in southern California; Protea, in southern California; Telopea (Waratah, Warratau), in California.

Order 30. Santalales

60. **Loranthaceæ** (from the genus *Loranthus*, meaning *thong flower*, significance not clear). Mistletoe Family. Fig. 17. Herbs or subshrubs, parasites or half-parasites, with or without chlorophyll, rarely rooted in the earth: leaves usually opposite, rarely alternate, thick and green, or reduced to scales: flowers bisexual or unisexual, usually regular; receptacle of the pistillate flower cup-shaped, united with the ovary; perianth undifferentiated, usually in 2 series of 2 or 3 parts each, of which the outer may be calyx and the inner corolla; stamens as many as the parts of the perianth and opposite them, free, or united with the perianth; ovary 1-celled, inferior; ovule 1, orthotropous; stigma 1, often sessile: fruit a 1-seeded berry.

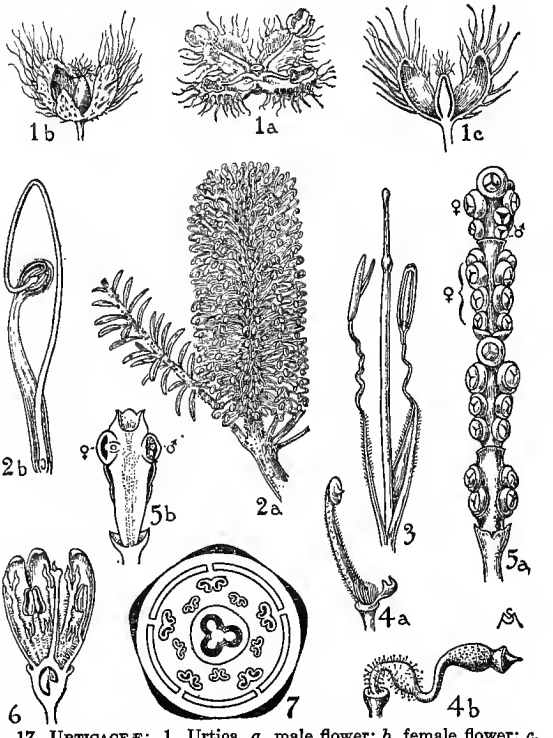
The 21 genera and about 600 species are mostly inhabitants of tropical countries, but extend into the temperate zone. One species reaches Newfoundland. Loranthus, the largest genus, contains 200 species, and Phoradendron contains 80 species. The family is related to the Santalaceæ and Proteaceæ. The habit, the cup-shaped receptacle, the position and number of the stamens, and the 1-celled, 1-seeded fruit are distinctive. The fruits are often very viscid and easily become fastened to the branches of trees where they germinate and grow. The inflorescence is often much reduced and inconspicuous.

The viscid substance of the fruit is called birdlime, and is used for catching small birds. Various species have been used locally as medicine. The mistletoe (*Viscum album*) of Europe was worshipped by the Gauls. When gathered from the oak it was considered sacred by the Druids.

Phoradendron flavescens (American mistletoe) is gathered and sold in the market.

61. **Santalaceæ** (from the genus *Santalum*, the Latin name for sandalwood). Sandalwood Family. A family closely related to the Loranthaceæ, from which it differs only in the more numerous ovules and the general habit. The Santalaceæ are commonly independent plants or root parasites, while the Loranthaceæ are usually aërial parasites.

The Santalaceæ consists of 26 genera and about 250 species, in the temperate and tropical regions.



17. Urticaceæ: 1. Urtica, *a*, male flower; *b*, female flower; *c*, female flower, vertical section. Proteaceæ: 2. Banksia, *a*, inflorescence; *b*, flower. 3. Protea, flower. 4. *a* and *b*, pistils of Proteaceæ. Loranthaceæ: 5. Phoradendron, *a*, inflorescence; *b*, vertical section inflorescence. Olacaceæ: 6. Liriosma, flower. 7. Liriosma, floral diagram.

The aromatic and sweet-scented wood of the tree, *Santalum album*, has been used medicinally, and is used in perfumery and cabinet-making. Other species of Santalum, also of Fusanus, Acanthosyris, Colpoon, and Exocarpus are also used in cabinet work. The sweet flesh of the fruit of some species, the thickened pedicels or oily seeds of others, are edible.

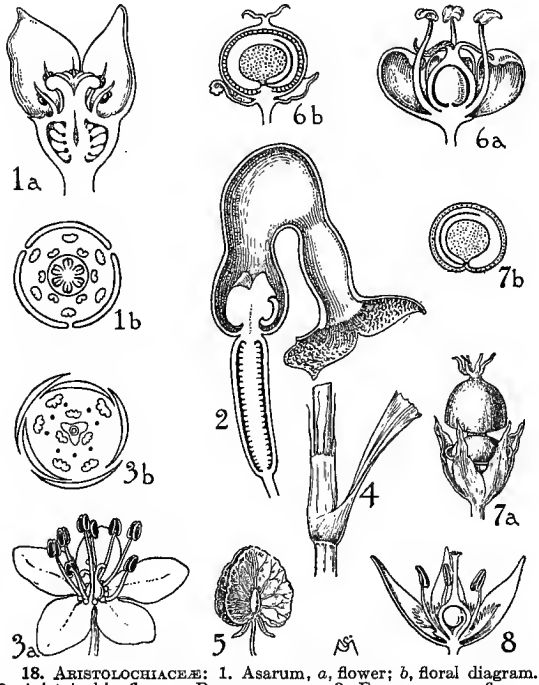
Queer tendril-like brushes on the fruits of the reduced aërial genus Myzodendron of South America serve as flying organs and later twine about the support.

Buckleya of the southeastern United States is sometimes cultivated; also Pyrularia.

62. **Olacaceæ** (from the genus *Olax*, signifying a furrow, application unknown). Olax Family. Fig. 17. Trees or shrubs, sometimes twining or climbing, with alternate, entire leaves: flowers mostly bisexual, regular; perianth single, the divisions (sepals?) 4–5, rarely 6,

valvate; stamens 4–10, often adnate to the perianth or connate; disk present, diverse; carpels 3, rarely 2–5; ovary superior, 1-celled, rarely falsely 3–5-celled; ovule 1; style 1: fruit usually a drupe inclosed in the accrescent and persistent perianth; seed albuminous.

Olacaceæ has 25 genera and about 140 species of tropical distribution, two of which reach southern Florida. Olax is the largest genus. The Olacaceæ are related to the Loranthaceæ and Santalaceæ.



18. ARISTOLOCHIACEÆ: 1. Asarum, *a*, flower; *b*, floral diagram. 2. Aristolochia, flower. POLYGONACEÆ: 3. Fagopyrum, *a*, flower; *b*, floral diagram. 4. Polygonum, sheathing stipule. 5. Rumex, fruiting calyx. CHENOPODIACEÆ: 6. Chenopodium, *a*, flower; *b*, fruit. AMARANTACEÆ: 7. Amarantus, *a*, fruit; *b*, vertical section seed. 8. Achyranthes, flower.

The family is of little economic importance. Some species are valuable for their hard timber. The drupes of Ximenia are eaten in Senegal. *Olax zeylanica* has a fetid wood, used locally for fevers.

One species, *Ximenia americana* (hog plum) is native in Florida and the tropics, and is of moderate value for the fruit.

Order 31. ARISTOLOCHIALES

63. **Aristolochiaceæ** (from the genus *Aristolochia*, in reference to its supposed medicinal properties in connection with child-birth). BIRTHWORT or DUTCHMAN'S PIPE FAMILY. Fig. 18. Herbs or woody plants, the latter mostly twining: leaves alternate, usually broad and entire: flowers bisexual, epigynous, regular or irregular; perianth of one series, the parts mostly 3, connate, often petaloid, very diverse, sometimes regular with the parts nearly separate, sometimes with a long tube which is swollen below, abruptly curved above, and with an abruptly spreading entire border; stamens 6–36, separate and inserted on the ovary, or united with the style; ovary inferior, rarely superior, 4- or 6-, rarely 5-, celled; ovules many; style 1; stigmas 4 or 6: fruit a capsule.

Five genera and about 210 species are known, 180 species of which belong to Aristolochia. They are distributed in the warm parts of the earth, but are most numerous in South America. Seven or 8 species are native in northeastern North America. The family is not definitely related to any other, but is placed provisionally near the Polygonaceæ, not however because related to that family, but because equally simple in structure. Three scale-like organs between the perianth and stamens in Asarum are probably true petals. The flowers of most Aristolochiaceæ are lurid in color and pollinated by flies. Many are carrion-scented and afford an additional attraction for these insects. The perianth in Aristolochia assumes remarkable shapes, some of which have led to the name "Dutchman's pipe."

The rootstock of *Asarum canadense* (Canada snakeroot or wild ginger) is aromatically peppery, and used to flavor wines, the breath, and the like. *Aristolochia reticulata*, of Arkansas, and *Aristolochia Serpentaria*, of the eastern United States, furnish the serpentaria of medicine, used as a tonic and as a febrifuge. The latter plant is Virginia snakeroot. The common name arises from the reputed efficacy of these plants and other species of the family as remedies for snake-bites.

The genera in cultivation in America are: Aristolochia (Birthwort, Virginia Snakeroot, Dutchman's Pipe, Pelican Flower, Goose Flower), hardy or greenhouse twiners; Asarum (Wild Ginger, Canada Snakeroot), low hardy border herbs.

Order 32. POLYGONALES

64. **Polygonaceæ** (from the genus *Polygonum*, derived from the Greek meaning *many knees* in reference to the swollen joints of some species). BUCKWHEAT FAMILY. Fig: 18. Herbs, shrubs, or trees, sometimes twining: stem often knotty: leaves alternate, rarely opposite, simple, usually with a sheathing stipular growth (ochrea) at the base: flowers bisexual or unisexual, regular; perianth apparently of one set, though sometimes in 2 whorls, the parts usually 3, 5, or 6, distinct or connate at base, the inner set sometimes much enlarged and modified with hooks, spines, wings, or tubercles; stamens 1–15, usually 6, 8, or 9, usually opposite the perianth parts, mostly separate and hypogynous; ovary superior or nearly so, compressed or 3-angled, of 2–4-carpels, but 1-celled or falsely 3-celled; ovule solitary; styles and stigmas 2–4: fruit a flat, angled, or winged achene; seeds usually not inverted (orthotropous).

Thirty genera and about 700 species occur, mostly in the north temperate zone of both continents. The largest genera are Polygonum, 150 species; Coccoloba, 125 species; Eriogonum, 120 species; and Rumex with 100 species. The family is not closely related to any other, but is usually placed near the Chenopodiaceæ because of its simple floral structure and for want of a better place. The stipular sheaths or, when absent, the involucrate heads (Eriogonum), and 1-celled fruit with a single orthotropous seed, are distinctive.

The foliage of the Polygonaceæ contains an acid, for which reason it is frequently eaten as salads or pot-herbs. Among plants used for this purpose are several species of Rumex, petioles of *Rheum Rhaponticum*, and Oxyria. The seeds of buckwheat (*Fagopyrum esculentum*) contain much starch and are made into flour. In medicine, rhubarb (*Rheum officinale*), employed as a purge and tonic, has been in use since earliest times, and its origin is lost in antiquity, though probably it is a native of China. Yellow dock (*Rumex crispus*) is a tonic. Smartweed (*Polygonum Hydropiper*) has an acrid juice that will produce a blister. A blue dye is obtained from *P. tinctorium* of China. The roots of *Calligonum Pallasia* are used in Siberia to stay hunger; and the fruits to quench thirst. The astringent drug, bistorta, is from *P. Bistorta*. The leaves of *P. orientale* are smoked like tobacco in China.

Several genera are in cultivation in America for ornament and food. Among these are: Antigonon (Mountain Rose, San Miguelito), very showy climbers; Coccoloba (Sea Grape, Shore Grape, Pigeon Plum),

trees both of greenhouse and the South, used for timber and edible fruit; Eriogonum, garden plants; Fagopyrum (Buckwheat), grain; Muehlenbeckia (cultivated as Coccoloba or Tapeworm Plant), greenhouse; Polygonum (Smartweed, Jointweed, Knotweed, Prince's Feather, Kiss-me-over-the-garden-gate, Lady's Thumb, Mountain Fleece, Secaline), hardy ornamental herbs; Rheum (Rhubarb, Pie-plant, Wine Plant), food, medicine, and ornament; Rumex (Dock, Sorrel, Sheep Sorrel, Canaigre, Rais Colorada, Herb Patience, Spinage Dock, Curly Dock), ornamental plants, food-plants and weeds.

Order 33. CENTROSPERMÆ

65. **Chenopodiaceæ** (from the genus *Chenopodium*, which means *goose foot*, from the shape of the leaves). GOOSEFOOT FAMILY. Fig. 18. Herbs, shrubs, or rarely small trees, often very fleshy with reduced branching and foliage, and very diverse and remarkable in form: leaves alternate, rarely opposite, often fleshy or reduced to scales: flowers bisexual or unisexual, regular, very small; perianth of one series, the parts 1–5, separate or united, greenish, imbricated, persistent; stamens as many as the perianth parts, or fewer, opposite them, hypogynous or borne on the perianth, often connate; hypogynous disk usually present; ovary superior, 1-celled, 1-ovuled; style and stigmas 1–4: fruit dry, rarely fleshy, usually indehiscent, inclosed in the very diverse perianth which is often hard, or fleshy, or thorny, or hooked; embryo coiled.

This family contains 73 genera and about 550 species, distributed all over the world, but principally confined to saline or alkaline habitats. A few have become weeds in good garden soil. The family is closely related to the Amarantaceæ, Phytolaccaceæ, Caryophyllaceæ and Portulacaceæ, all of which have an annular embryo. The fleshy habit, absence of scarious bracts, 1-celled, 1-seeded ovary, and coiled embryo are distinctive. A remarkable family of littoral plants, often with water-storing tissue, spines, queer fruits, and the like.

The most important economic species is the beet (*Beta vulgaris*), the enlarged root of which is used for food and for sugar, the foliage as a pot-herb. Species of Chenopodium, Atriplex, Spinacia and others are eaten as greens. Of these spinach is the most famous. The young shoots of Salicornia (glasswort, marsh samphire) are eaten as a pot-herb and are pickled. These shoots are also used for making glass and soaps because of the soda contained. The seeds of *Chenopodium Quinoa* are made into flour in Peru. The foliage of *Chenopodium Botrys* and *Chenopodium ambrosioides* is fragrant-scented. The seeds of *Chenopodium anthelminticum* (wormseed) are a well-known vermifuge. *Chenopodium mexicanum* yields saponin. *Atriplex hortensis* (orach) of Europe and Asia, yields an indigo dye, and the leaves are edible. Soda is obtained by burning many species. *Salsola Kali* var. *tenuifolia* (Russian thistle) is a bad weed.

Several genera are in cultivation in America, largely for food, but some for ornament. Among these are: Atriplex (Orach, Sea Purslane), food and ornament; Beta (Beet, Mangel-wurzel, Mangel, Chard, Swiss Chard, Spinach Beet), food and ornament; Chenopodium (Good King Henry, Mercury, Markery, Feather Geranium, Jerusalem Oak, Wormseed, Mexican Tea), ornament, food, medicine; Cycloloma (Cyclone Plant), ornament; Kochia (Mock Cypress), ornament; Spinacia (Spinach, Spinage), food.

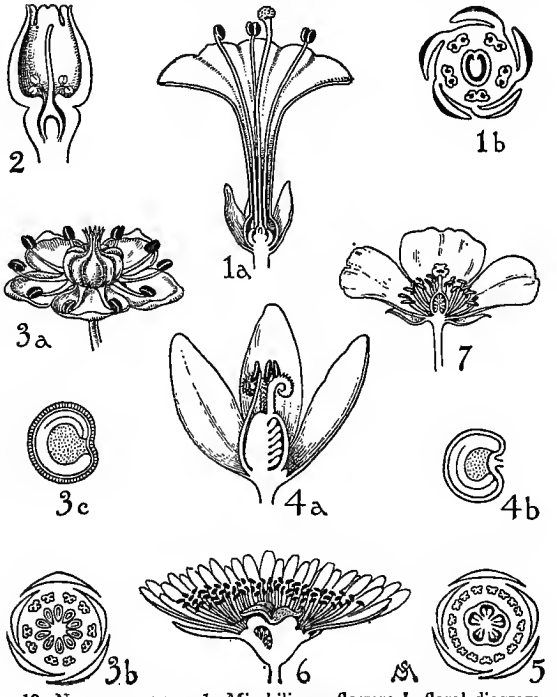
66. **Amarantaceæ** (from the genus *Amarantus*, derived from the Greek, signifying *unfading*; the bracts are scarious and unchanging). AMARANTH FAMILY. Fig. 18. Herbs, shrubs, or rarely trees: leaves opposite or alternate, rarely fleshy: flowers bisexual or unisexual, small, regular, usually surrounded by scarious bracts; perianth simple, in one series of 5, rarely 1, 2, 3, or 4, separate or united parts; stamens opposite the perianth parts, of the same number or fewer, rarely more numerous, hypogynous or perigynous, separate or united, the stamen-tube often with fringed appendages at the top; hypogynous disk usually present; ovary superior, free or slightly united with the perianth, 1-celled, 1 to many-seeded; style 0, or 1, or several; stigmas various: fruit a berry, an achene, or dehiscent by a lid; usually surrounded by the perianth; embryo coiled.

The 40 genera and about 450 species are distributed everywhere except in the arctics; most abundant within the tropics. The family is very closely related to the Chenopodiaceæ and Phytolaccaceæ, also to the Caryophyllaceæ and Portulacaceæ. The single perianth, scarious persistent bracts, and 1-seeded fruit are distinctive.

Many species of Amarantus are eaten as greens. *Gomphrena arborescens* is a tonic. Many Amarantaceæ are weeds in cultivated grounds. Some are important ornamental plants. The garden forms of *Celosia cristata* are remarkable for their fasciated inflorescence.

In cultivation in America are: Amarantus (Lovelies-bleeding, Prince's Feather, Joseph's Coat), garden annuals; Bosea, ornamental; Celosia (Cockscomb), garden annuals; Gomphrena (Globe Amaranth, Bachelor's Button), garden annual; Iresine or Achyranthes, bedding plants; Telanthera (Alternanthera), bedding plants; Trichinium or Ptilotus, greenhouse.

67. **Nyctaginaceæ** (from the generic name *Nyctago*, a synonym of Mirabilis, meaning *night*, in reference to the crepuscular or nocturnal flowering of the Four-O'clock). FOUR-O'CLOCK FAMILY. Fig. 19. Herbs, shrubs, or trees: leaves usually opposite, entire: flowers bisexual, rarely unisexual, surrounded by an involucre of separate or united bracts which incloses 1 or several flowers; corolla absent; perianth parts united, very diverse in consistency, form and color, often petaloid,



19. NYCTAGINACEÆ: 1. Mirabilis, *a*, flower; *b*, floral diagram, 2. Neea, flower. PHYTOLACCACEÆ: 3. Phytolacca, *a*, flower; *b*, floral diagram; *c*, vertical section of seed. AIZOACEÆ: 4. Mollugo, *a*, flower; *b*, vertical section of seed. 5. Aizoon, floral diagram. 6. Mesembryanthemum, flower. PORTULACACEÆ: 7. Calandrinia, flower.

valvate or plicate, persistent after flowering, and often woody or leathery, enveloping the fruit; stamens 1–30, united at the base, unequal, hypogynous; ovary of 1 carpel, 1-celled, 1-ovuled; style 1; stigma 1: fruit an achene.

The family has 18 genera and about 150 species, principally natives of America from Colorado to Chile. A few are scattered in other parts of the world. The largest genus is Pisonia with 40 species; Neea has 30 species. The family is related to the Phytolaccaceæ. The floral bracts, absence of corolla, persistent perianth enveloping the very thin-walled fruit, and the 1-seeded, 1-celled ovary, are distinctive

The roots of Bœrhavia and of *Mirabilis Jalapa* are purgative, and are sold as a substitute for jalap. The foliage of several species of Bœrhavia is used as vegetables. The natives of the Hawaiian Islands catch birds with the very sticky fruits of the native species. The leaves of *Neea theifera* are used as tea in Brazil, also as a black dye.

In America 3 genera are in common cultivation: Abronia, garden annuals; Bougainvillæa, greenhouse shrubs; Mirabilis (Four-o'clock, Marvel of Peru).

68. **Phytolaccaceæ** (from the genus *Phytolacca*, derived from the Greek meaning *plant* and *lac*, in reference to the red juice of the fruit). POKEWEED FAMILY. Fig. 19. Herbs, shrubs, or trees: leaves mostly alternate, simple: flowers bisexual, rarely unisexual, regular; perianth of one series, divisions 4–5, separate, persistent, not modified in fruit; stamens of the same number as the parts of the perianth and alternate with them, or more numerous, often connate at base, hypogynous; disk obscure or annular; ovary usually superior, rarely inferior; carpels 1 to many, free, or united into a several-celled ovary; ovules 1 for each carpel; styles as many as the carpels: fruit a berry, utricle, nut, or samara; embryo curved.

The pokeweed family contains 22 genera and about 100 species, mostly of tropical and subtropical America and South Africa. One species reaches the eastern United States. All the genera are small. The family is related to the Aizoaceæ; also to the Caryophyllaceæ, Chenopodiaceæ, Nyctaginaceæ, and other families with curved embryos. The several 1-seeded carpels and non-accrescent perianth are usually distinctive.

The red juice of the fruit of *Phytolacca decandra* was used by the American Indians for staining baskets, and the like. The roots of this plant are medicinal (emetic, cathartic), and the young shoots are eaten.

A few genera are in cultivation in America. Among these are Phytolacca (Pokeberry, Pokeweed, Scoke, Garget, Pigeonberry, Inkberry), native, hardy, rarely cultivated as a pot-herb; and Rivina (Rough Plant), ornamental garden and greenhouse plants.

69. **Aizoaceæ** (from the genus *Aizoon*, derived from the Greek meaning *always alive*, in reference to the persistence of life in desert habitats). CARPET-WEED or ICE-PLANT FAMILY. Fig. 19. Erect or prostrate, often fleshy herbs or sub-shrubs, either the stem or the leaves, or both, curiously modified to reduce surface and store water; rarely ordinary herbaceous plants: leaves opposite, alternate or whorled, simple and mostly entire: flowers bisexual, regular, hypogynous or epigynous; perianth of one set of 4–5 separate or united parts; stamens 5, alternating with the perianth parts, or by the splitting up of each becoming very numerous, in which case many of the outer are changed into long, showy, petaloid staminodia, the whole then somewhat resembling the head of an aster; ovary 2–20-celled, superior or inferior; placentæ axial, basal, or parietal; ovules mostly numerous; stigmas 2–20: fruit capsular or nut-like; embryo curved or annular.

Eighteen genera and about 500 species are known, of which 300 belong to the genus Mesembryanthemum; mostly inhabitants of the desert or, at least, dry portions of tropical and south-tropical regions. The large genus, Mesembryanthemum, is almost exclusively South African, but reaches the Mediterranean. One species of Aizoaceæ (Sesuvium) is native in the eastern United States. The family is related through some genera to the Phytolaccaceæ; through others to the Caryophyllaceæ and Portulacaceæ. The annular embryo places the Aizoaceæ in this group. The apetalous, often falsely polypetalous, flowers, with several-celled ovary, and curved embryo, are characteristic.

The fruits of *Mesembryanthemum edule* (Hottentot fig) are edible. The leaves of Mesembryanthemum are used as a vegetable on the borders of the African desert. *Tetragonia expansa* (New Zealand spinach) is cultivated as a pot-herb. *Mesembryanthemum crystallinum* (ice-plant) of the Mediterranean region, with leaves covered with peculiar vesicular hairs filled with a viscid liquid, which sparkles in the sunlight like frost, is cultivated as a curiosity. Other species are cultivated for their strange appearance.

Many species of Mesembryanthemum (Fig. Marigold, and Ice-plant) are more or less cultivated in America; also one species of Tetragonia (New Zealand Spinach, New Zealand Ice-plant).

70. **Portulacaceæ** (from the genus *Portulaca*, an old Latin name of unknown origin). PURSLANE FAMILY. Fig. 19. Herbaceous or suffruticose: leaves often fleshy, sometimes connate: flowers bisexual, usually regular; sepals 2; petals 4–5, rarely more, sometimes connate at the base, fugaceous; stamens in 1 or 2 whorls, hypogynous (except in Portulaca), equal in number to the petals and opposite them, or double the number and alternating with them, or fewer, or, by multiplication, very many; ovary 1-celled, with a free-central or basal placenta; ovules 2 to many; style 2–3-parted: fruit a capsule, opening by a valve or lid, rarely indehiscent; embryo curved or annular.

Most of the 17 genera and about 150 species are inhabitants of the warmer, dry or arid regions, for which their fleshy structure and frequently prostrate or cæspitose habit are an adaptation. They are most abundant in South America and the Cape of Good Hope; also common in western North America. The Portulacaceæ are most closely related to the Caryophyllaceæ and Aizoaceæ. The 2 sepals, 1-celled ovary with central placenta, several styles, and curved or coiled embryo are distinctive. In the common purslane and a few other species, the capsule opens by a terminal lid, which, separating along a transverse line, falls off and thus allows the seeds to escape. In Portulaca the ovary is partly inferior.

Most of the Portulacaceæ are mucilaginous; some are slightly bitter and have been used as a mild tonic. The herbage of *Portulaca oleracea* is eaten as a salad or as greens, and is also said to be sedative and an antidote for scurvy. Several species of Calandrinia, Talinum and Claytonia, are used as pot-herbs. The roots of *Claytonia tuberosa* of Siberia are edible, as are also the roots of the western Lewisia.

About one-third of the genera are in cultivation in America. *Portulaca grandiflora* (Rose Moss) is ornamental; *P. oleracea* (Purslane or Pusley) is a pot-herb; the Montias are also pot-herbs. Lewisia, Talinum, Spraguea and Claytonia are mostly ornamental.

71. **Basellaceæ** (from the genus *Basella*, the Malabar name of the plant). BASELLA FAMILY. Fig. 20. Climbing, perennial herbs, rarely slightly woody: leaves alternate, broad, often fleshy: flowers bisexual, regular, 2 bracteolate; sepals 2; petals 5, separate or connate, imbricated, persistent; stamens 5, opposite the petals and attached to their base; ovary superior, 1-celled; ovule 1, basal, curved; style and stigma 1–3: fruit indehiscent, inclosed in the corolla; embryo spiral.

There are 5 genera and about 15 species, all except one species being confined to tropical America, mostly in the Andes. Boussingaultia, the largest genus, contains 10 species. The family is related to the Cheno-

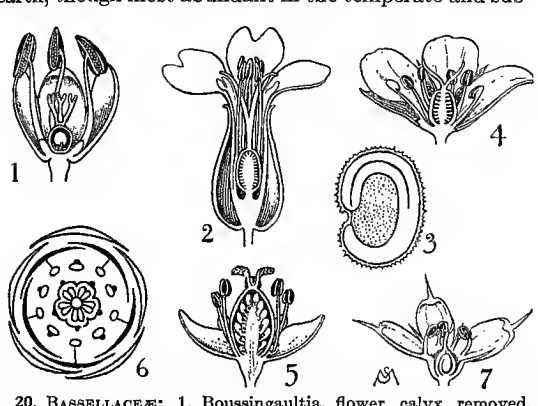
podiaceæ with which it has been united; also to the Polygonaceæ and Portulacaceæ. The twining stem, and the two sets of floral envelopes, together with the 1-celled ovary and single seed, are distinctive.

Basella alba (red and white spinach) is eaten as a pot-herb. The starchy root of *Ullucus tuberosus* is eaten in Peru. It is used as a substitute for the potato, which it resembles.

The genera apparently in cultivation in America are: Anredera; Basella (Malabar Nightshade), grown as ornamental greenhouse plants, or eaten as spinach; and Boussingaultia (Madeira Vine, Mignonette Vine), ornamental garden or greenhouse plants.

72. **Caryophyllaceæ** (from the genus *Caryophyllus*, an old botanical name for the clove pink [Dianthus], the application of the name obscure). PINK FAMILY. Fig. 20. Herbs, rarely suffruticose, with opposite entire leaves: flowers bisexual, rarely unisexual, regular; sepals 5, separate or united; petals 5, rarely wanting; stamens twice as many as the petals, rarely fewer, hypogynous or perigynous; carpels 3–5; ovary superior, 1-celled with a free-central or basal placenta; ovules 1 to many; styles 3–5: fruit a capsule, rarely a berry, opening by valves or indehiscent; seed albuminous; embryo strongly curved or coiled.

The pink family consists of 70 genera and from 1,200–1,500 species, distributed over all parts of the earth, though most abundant in the temperate and sub-



20. BASSELLACEÆ: 1. Boussingaultia, flower calyx removed. CARYOPHYLLACEÆ: 2. Silene, flower. 3. Agrostemma (Lychnis), seed. 4. Arenaria, flower. 5. Sagina, flower. 6. Spergula, floral diagram. 7. Paronychia, flower.

arctic zone. Many have become weeds in cultivated ground and are now very widely dispersed. The Caryophyllaceæ are related to the Chenopodiaceæ, Amarantaceæ, Phytolaccaceæ, Portulacaceæ, Nyctaginaceæ and Aizoaceæ, all of which have a coiled, curved or annular embryo. Of these, the Phytolaccaceæ probably represent more nearly the ancestral type. By most recent authors (see Pax) the Illecebraceæ (Paronychia, Anychia, Scleranthus and Herniaria) are included in the Caryophyllaceæ. The curved embryo, the 1-celled ovary with several styles and central placenta, the 10 stamens, the 5 separate petals and the opposite entire leaves are together distinctive.

The family is very naturally divided into two distinct tribes: *Tribe I. Silenoideæ.*—Sepals united forming a tubular calyx; stamens hypogynous. This includes Silene, Lychnis, Dianthus, Tunica, Saponaria and Gypsophila.

Tribe II. Alsinoideæ.—Sepals separate; stamens mostly perigynous. Includes Spergula, Cerastium, Stellaria, Arenaria, Sagina, Paronychia, Anychia, Herniaria and Scleranthus.

In the Silenoideæ, the long-clawed petals often have a scale at the top, the five together forming a tiny crown. Some species of Silene and Lychnis flower only at night or in cloudy weather, and are pollinated by night-flying moths. The bracts at the base of the flower in Dianthus are distinctive. The petals of chickweed are curiously 2-parted, simulating 10 petals.

The Caryophyllaceæ are of little economic importance. Some were formerly used in medicine, but have fallen into disrepute. The roots of *Saponaria officinalis* contain a saponaceous substance, saponin, and have been used for washing, whence the common name "soapwort." Saponin is a powerful local irritant, and, if applied strong, is said to kill either muscular or nervous tissue. *Spergula arvensis* has been used as a fodder plant. Many members of the family are well-known ornamental plants, of which the most famous is *Dianthus Caryophyllus*, the carnation pink.

Perhaps 20 genera (including Illecebraceæ) are grown, mostly for ornament. Among these are: Arenaria (Sandwort); Cerastium (Mouse-ear Chickweed); Dianthus (Carnation, Clove Pink, China Pink, Plumed Pink, Sweet William, Picotee, Grenadine); Gypsophila (Baby's Breath); Lychnis (Ragged Robin, Maltese Cross, Dusty Miller); Paronychia (Whitlow-wort); Sagina (Pearl-wort); Saponaria (Bouncing Bet, Soapwort, Cow Herb); Silene (Catchfly, Campion, Wild Pink); Spergula (Spurry); Stellaria (Chickweed, Starwort); Tunica.

Order 34. RANALES

73. **Nymphæaceæ** (from the genus *Nymphæa*, a name intended for the white water-lilies; dedicated by the Greeks to the water nymphs). WATER-LILY FAMILY. Fig. 21. Aquatic herbs: leaves alternate: flowers usually bisexual, regular, the organs, in part at least, spirally arranged; sepals mostly 4, rarely 3, 5, 6, or 12; petals 3-many, usually very numerous, hypogynous, or more or less epigynous, often a distinct transition to the stamens; stamens very numerous (rarely 6), inserted with the petals; carpels rarely 3–4, usually many, rarely distinct, usually cohering in a whorl or sunken in the enlarged receptacle; stigmas radially arranged on a sessile disk (as in poppy) or single: fruit indehiscent or irregularly dehiscent, usually fleshy; seeds several.

Nymphæaceæ has 8 genera and about 60 species, distributed in all parts of the world, but more especially in tropical South America. The family is closely related to the other families with spiral structure of the flower, as the Ranunculaceæ, Magnoliaceæ and Dilleniaceæ. There is also a relation to Podophyllum of the Berberidaceæ, and to the Papaveraceæ. The habit, spiral arrangement of floral parts, when present, the numerous stamens, the usually coherent carpels, and the type of fruit, are characteristic.

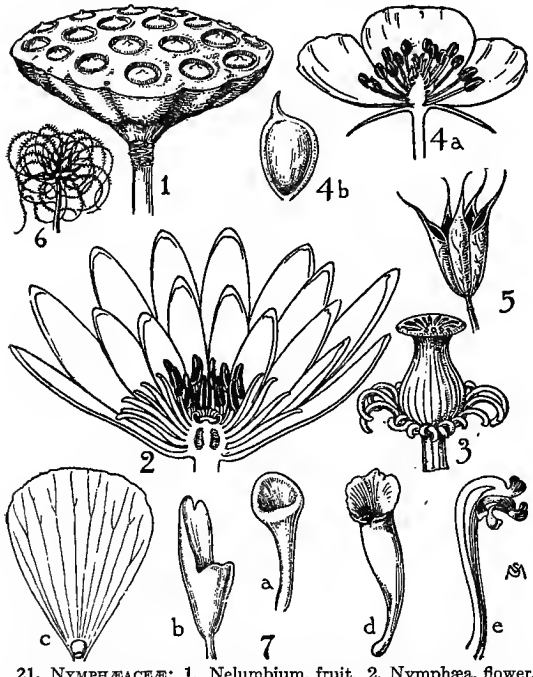
The leaves of Nelumbo are raised on long petioles, those of Nymphæa usually float, those of Brasenia are covered with a thick layer of slime, those of *Victoria regia* are 5–8 feet in diameter and floating. The receptacle of Nelumbo in fruit is like an inverted top with the ripe 1-seeded carpels loosely rattling in small cavities on the flat surface. The Nymphæaceæ in stem-structure and character of the embryo shows a transition to the monocotyledons.

Because of their unique appearance among plants, some species were venerated by the ancients. The lotus of the Egyptians, represented on their monuments and statues of their gods 5,000 years ago, was *Nymphæa cærulea* or *N. Lotus*, though *Nelumbo nucifera* has long passed under that name. (See article on Nymphæa.) The rootstocks of the Nymphæaceæ contain abundant starch, mucilage and sugar, which render them nutritive. The seeds are edible and the negroes of the Nile used them as millet. The Egyptians still eat the seeds and rootstocks. The seeds and rootstocks of *Euryale ferox* are cultivated and eaten in China.

In the American trade a few genera appear. Cabomba (Fish-Grass), with dissected submerged leaves and

white flowers, is grown in aquaria; Brasenia (Water Shield) is grown in aquatic gardens, as are also various species of Nuphar (Yellow Water-Lily, Spatterdock, Cow Lily); Nymphæa (White Pond-Lily); Nelumbo (Indian Lotus, so-called Egyptian Lotus, and Water Chinquapin); *Victoria regia;* and the similar *Euryale ferox*. The white water-lilies have latterly been called Castalia, but the name Nymphæa as applied to them has good historical standing and is retained in this work; Nuphar is still held for the yellow pond-lilies.

74. **Trochodendraceæ** (from the genus *Trochodendron*, from the Greek *wheel*, plus *tree*). TROCHODENDRON FAMILY. Trees or shrubs: leaves alternate or opposite, with oil-glands: flowers bisexual or unisexual,



21. NYMPHÆACEÆ: 1. Nelumbium, fruit. 2. Nymphæa, flower. 3. Nuphar, fruit. RANUNCULACEÆ: 4. Ranunculus, *a*, flower; *b*, fruit. 5. Aquilegia, fruit. 6. Clematis, fruit. 7. Petals of various genera, *a*, Coptis; *b*, Eranthis; *c*, Ranunculus; *d*, Aquilegia; *e*, Aconitum.

regular, hypogynous or perigynous; sepals and petals wanting; stamens numerous, spirally arranged; carpels separate, sometimes half immersed in the receptacle, 2 to many in one whorl; ovules 1 to many: fruit a follicle, or indehiscent.

Only 3 genera and 6 species are known, all of Eastern Asia. The family is closely related to the Magnoliaceæ, in which it has been included by many authors. It has the same spiral structure of the flower, and separate carpels, but the perianth is wanting.

Trochodendron is one of the very few angiosperms in which the secondary wood is made up entirely of tracheids with bordered pits, without true vessels, as in the Coniferæ.

The family is of little economic value. The wood of some species is used locally. In America, *Cercidiphyllum japonicum* and *Euptelea polyandra* are in cultivation as hardy, ornamental woody plants.

75. **Ranunculaceæ** (from the genus *Ranunculus*, from the Latin signifying a little frog, because many of these plants are aquatic or marsh plants). BUTTERCUP FAMILY. Fig. 21. Herbs or shrubs of diverse habit: flowers bisexual rarely unisexual, spirally constructed except often the perianth, regular or irregular; sepals 3 to many, usually 5, separate, often petaloid; petals 3 to many, or 0, often in the form of honeyglands; stamens usually very numerous, hypogynous; carpels 1 to many, usually separate: fruit an achene or follicle, rarely a capsule or a berry; seeds with endosperm.

The 27 genera and about 680 species are distributed mainly in the north temperate and subarctic regions. Clematis, Anemone and Delphinium cross the equator southward. The largest genus is Ranunculus. The family is related to the Magnoliaceæ, Annonaceæ, Dilleniaceæ, Nymphæaceæ, and other families with acyclic flowers and numerous carpels. The spiral floral structure, the numerous hypogynous stamens, and the usually separate carpels are the most distinctive characteristics. The Ranunculaceæ is probably a very old family, and by some authors is thought to represent more closely than others the stock from which the dicotyledons have sprung.

The floral structure is very interesting and very variable. The petals, when not wanting, are rarely normal. In one series a transition is shown from the staminode-like nectary of Coptis to the petal-like nectary of Ranunculus; in another series the nectar-bearing petals are spurred or variously irregular, as in Aconitum, Delphinium and Aquilegia. In the last two genera, the flowers also have become extremely irregular. The fruits show an equally great diversity. From the primitive follicular type, they have become modified into achenes with a suspended or erect ovule, into a berry, or, in Nigella, even into a several-celled capsule by the fusion of the carpels. The wind-pollinated Thalictrum shows great reduction and modification on that account. The stalked carpels of Coptis simulate an umbel of separate fruits. Finally the foliage of several species of Ranunculus has become very much dissected on account of the aquatic habit, and the plants, therefore, simulate a Myriophyllum.

The Ranunculaceæ is divided by Prantl into three tribes as follows:

Tribe I. Fruit follicular, carpels fleshy, outer seed-coat long, e.g. Pæonia and Hydrastis.

Tribe II. Fruit usually follicular, carpels rarely fleshy, outer seed-coat not longer than the inner, e.g., Caltha, Helleborus, Coptis, Actæa, Aquilegia, Delphinium, etc.

Tribe III. Fruit an achene, e.g., Anemone, Clematis, Ranunculus, Thalictrum, etc.

The family contains many plants useful to mankind. Many are cultivated for their ornamental flowers. The seeds, leaves and roots contain a bitter acid principle which is very irritating and in many cases poisonous. Because of this, many species of Anemone, Clematis, and so on, have been used to produce blisters, and beggars are said to have made use of *C. Vitalba* to produce artificial sores and thus excite pity. The roots of Coptis (gold-thread) are bright yellow, and have been used both as bitters and for the dye-stuffs contained. Hydrastis (golden seal) is a well-known tonic and stomach corrective. Aconite is a powerful narcotic drug much used to allay fever. Slow cooking usually dissipates the poisonous properties of the Ranunculaceæ, thus enabling the vegetative portion in many cases to be eaten as greens. *Ranunculus Thora* and *R. sceleratus* were named by the Romans "sardonia" because they are said to excite convulsive sardonic laughter.

Two dozen or more genera are in cultivation in America, almost entirely for ornamental purposes. Among these are: Aconitum (Aconite, Monkshood, Wolfsbane); Actæa (Baneberry, Red and White Cohosh); Adonis (Pheasant's Eye, Adonis); Anemone (Anemone, Windflower, Patens, Pasque Flower); Aquilegia (Columbine); Caltha (Marsh Marigold, American Cowslip); Clematis (Virgin's Bower); Coptis (Goldthread); Delphinium (Larkspur); Eranthis (Winter Aconite); Helleborus (Christmas Rose); Hydrastis (Golden Seal, Orange Root); Nigella (Love-in-a-Mist, Devil-in-a-Bush, Fennel Flower); Pæonia (Peony, Piney);

Ranunculus (Buttercup, Crowfoot); Thalictrum (Meadow Rue); Trautvetteria (False Bugbane); Trollius (Globe Flower); Xanthorrhiza (Shrub Yellow Root).

A considerable industry has recently sprung into existence in which Hydrastis is grown for the medicinal value of the roots.

76. **Lardizabalaceæ** (from the genus *Lardizabala*, named in honor of a Spanish naturalist, Lardizabala y Uribe). LARDIZABALA FAMILY. Mostly twining plants with palmately compound leaves: flowers polygamous or unisexual, rudiments of the other sex organs present, regular, hypogynous; sepals 6; petaloid, in two whorls, petals none; stamens 6, hypogynous; usually with nectaries between stamens and petals; carpels 3, rarely 6–9 or numerous, separate; ovules many rarely one, parietal; fruiting carpels baccate, indehiscent or dehiscent.

This family has 8 genera and 18 species, inhabitants of the Himalayas, China, Japan, and Chile. The family is related to the Berberidaceæ, with which it was formerly united, and to the Menispermaceæ, from both of which it is distinguished by the several-seeded fruit and by other characters.

The fruits of most species are edible. The stems of Boquila and Lardizabala are used as cordage.

Lardizabala, Stauntonia, Akebia and Sargentodoxa are in the American trade.

77. **Berberidaceæ** (from the genus *Berberis*, derived from Berberys which is the Arabic name of the fruit). BARBERRY FAMILY. Fig. 22. Herbs or shrubs with large, compound leaves, or small and simple, or spine-like leaves: flowers bisexual, regular, hypogynous; sepals 3–9 in 1–3 series; petals 4–9 or more, in several whorls, often changed to nectaries; stamens as many as the petals and opposite them, rarely twice as many; anthers peculiar, opening by valves which roll upward; ovary 1-celled with several ovules; style almost 0; stigma mostly peltate: fruit a berry or capsule.

The family Berberidaceæ has 8 genera and about 200 species, distributed through north temperate Europe, Asia and America. Berberis extends along the Andes to the Straits of Magellan. Fossil species in the Tertiary are known. The family is related to the Ranunculaceæ, Papaveraceæ and Fumariaceæ. There is also an evident relation to the Magnoliaceæ and Annonaceæ. The cyclic flowers, definite stamens opposite the petals, the solitary carpel, and usually the dehiscence of the anthers are distinctive. In Podophyllum, the anthers open longitudinally in the ordinary way, and the stamens are twice the number of the petals. The stamens of Berberis are irritable, flying toward the stigma when touched, and then scattering the pollen.

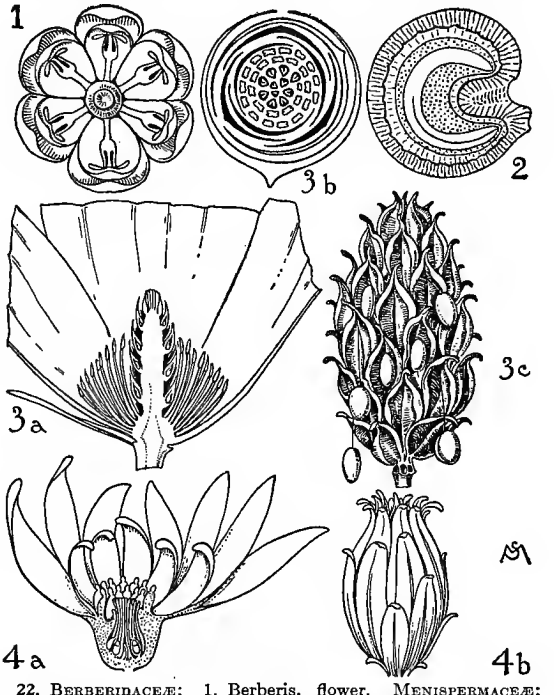
The fruit of the common barberry (*Berberis vulgaris*) contains oxalic acid and is used as a preserve; the yellow inner bark and stems are astringent and yield the yellow "berberine," which is also a purgative. This yellow color formerly induced doctors to administer Berberis for jaundice. The fruits of the mahonias of California are also eaten as a preserve. The wood of the Indian and South American species of Berberis is used as a dye. The root of Podophyllum (mandrake or May apple) is purgative and poisonous; the ripe fruit of this plant is fleshy and edible. Many other species have been used for medicine in various parts of the world. *Berberis vulgaris* is the famous host-plant of the æcidial stage of the wheat rust.

The genera that are in the American trade are mostly grown as unusual herbaceous plants in gardens and are not widely known. Many species of the shrubby and spiny Berberis, and also of Mahonia, are grown for ornamental purposes. Akebia, a well-known woody twiner with palmate leaves and curious purple flowers, is now placed in the Lardizibalaceæ.

78. **Menispermaceæ** (from the genus *Menispermum*, derived from the Greek meaning *moonseed*). MOONSEED FAMILY. Fig. 22. Woody climbers: leaves alternate: flowers dicecious, regular; sepals usually 6, in 2 series; petals 6, in 2 series; stameus 6, hypogyuous, opposite the petals, sometimes monadelphous; carpels usually 3, rarely more, separate, 1-ovuled, much curved in fruit; seed half-inverted; embryo usually curved: fruit compound of sessile or stipitate drupelets.

There are 56 genera and 150 species, distributed mostly in the tropical and subtropical portions of both hemispheres. None are found in Europe. Three species are native in the northeastern United States. The Menispermaceæ are related to the Berberidaceæ, the Annonaceæ and the Magnoliaceæ. The numerical plan of 3, the 2 whorls of sepals and petals, the curved seed, the drupelets, and the absence of oil-glands, are distinctive. Cross-sections of the twining stems often present peculiar patterns due to the unequal growth of the cambium.

Several species are used in medicine. *Jateorhiza palmatus* of tropical Africa has a turnip-shaped root which was much used as a tonic. The roots of species of Cissampelos are administered in Brazil in cases of snake-bites. The bark of several species yields a yellow dye. *Anamirta Cocculus* of tropical Asia has extremely poisonous fruits (fish-berries or cocculus) used to intoxicate and poison fish which are thus obtained in abundance, but are sometimes dangerous to eat. The narcotic principle, picrotoxine, is almost as poisonous as strychnine. In England, beer is said sometimes to



22. BERBERIDACEÆ: 1. Berberis, flower. MENISPERMACEÆ: 2. Menispermum, fruit. MAGNOLIACEÆ: 3. Magnolia; *a*, flower; *b*, floral diagram; *c*, fruit. CALYCANTHACEÆ: 4. Calycanthus; *a*, flower; *b*, fruit.

be adulterated with the fruit (called cocculus indicus) of this plant.

Few genera are in cultivation in America for ornamental purposes, mostly in the southern states, and especially Florida: Cissampelos (Velvet Leaf or Pareira Brava), tonic and diuretic, in Florida; Menispermum (Moonseed Vine, from the curved fruit), hardy, native; *Cocculus carolinus* of the southeastern United States, semi-hardy; *C. triloba*, E. Asia, hardy.

79. **Magnoliaceæ** (from the genus *Magnolia*, which was dedicated to P. Magnol, a professor of Botany at

Montpellier in the 17th century.) MAGNOLIA FAMILY. Fig. 22. Woody plants with alternate, entire or lobed leaves, and usually large stipules, each pair of which forms a hood over the young growth above, the outer pair of stipules serving as bud-scales, and each pair leaving a scar which completely encircles the stem: flowers usually bisexual, regular, hypogynous, the parts spirally arranged except sometimes the sepals and petals; sepals 3; petals 6 to many, separate; stamens very numerous; carpels usually many and usually separate; ovary 1-celled, 1- to several-seeded, arranged spirally or in a whorl (Illicium) at the top of the receptacle: fruit a follicle, or samara, or indehiscent and fleshy.

Ten genera and about 80 species are distributed principally in the subtropical and temperate portions of Asia and America, but are absent in Africa, Europe and the arctic regions. The Magnoliaceæ are most closely related to the Annonaceæ and Calycanthaceæ. The peculiar stipules, the spiral structure of the hypogynous flower, and the separate carpels are distinctive. In Magnolia, the outer seed-coat is fleshy and red; when ripe the seeds fall out but remain suspended by the uncoiled spiral vessels of the raphe and funiculus.

The wood is generally valuable for timber, while all parts, such as leaves and bark, contain a bitter resin, which in some species is fragrantly aromatic. *Michelia Champaca* is cultivated in tropical Asia for its sweet flowers which are carried about as a perfumery. Its aromatic and acrid bark and buds are used in rheumatism. The bark of *Talauma elegans* is used in Java as a stomachic. The seeds of *Magnolia Yulan* have been used from prehistoric times in China as a febrifuge. It is said that the aromatic bark of the tulip tree is a substitute for cascarilla and quinine. *Drimys Winteri* has long been used as a stimulant in Central and South America, and, by importation, in Europe. The fruit of *Illicium verum*, a Chinese shrub, is very pleasantly aromatic, resembling anise, from which, and its remarkable star-like whorled carpels, it is called "star anise." It is much used as a condiment in oriental countries. The bark of *Illicium anisatum* (*I. religiosum*) was formerly burned as incense in the temples of Japan. For a long period the name *Illicium anisatum* was thought to apply to the star anise, but this mistake was rectified in the B.M. 7005. *Liriodendron Tulipifera* furnishes the valuable "whitewood" or "yellow poplar" of commerce. The wood of various species of Magnolia is used in cabinet-work.

Several genera are in cultivation in America, all except Illicium as ornamental trees and shrubs. Among these are: Illicium (Star Anise); Liriodendron (Tulip Tree); Magnolia (Magnolia, White Bay, Beam Tree, Cucumber Tree); and Schizandra, a procumbent warty shrub.

80. **Calycanthaceæ** (from the genus *Calycanthus*, derived from the Greek, which means a *cup* and *flower*, referring to the peculiar receptacle). CALYCANTHUS FAMILY. Fig. 22. Shrubs with opposite leaves and aromatic bark: flowers bisexual, regular, perigynous, spirally constructed; parts of the perianth numerous, petaloid, not clearly differentiated into calyx and corolla; stamens 10–30 (5 in Meratia); carpels numerous, separate, inserted on the inner face of the hollow receptacle, each 1–2-ovuled, in fruit forming 1-seeded achenes, which are completely inclosed by the fleshy receptacle; seeds, exalbuminous; cotyledons spirally rolled.

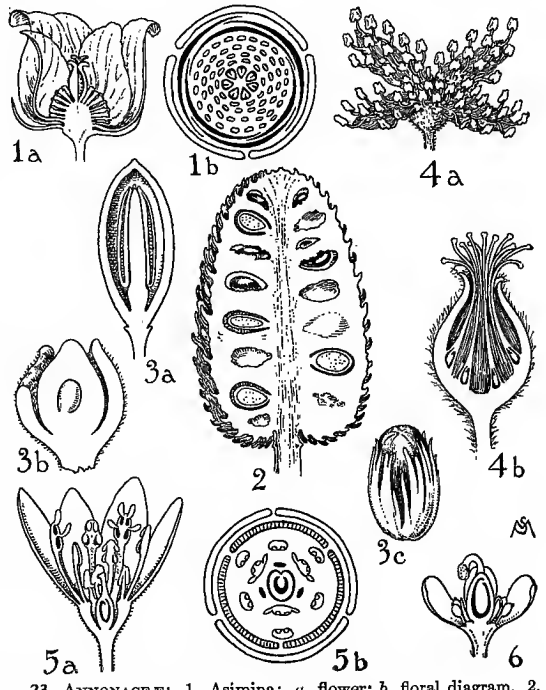
Calycanthus, with 4–6 species, is confined to the southern United States and California; Meratia has two species in China and Japan. The family is related to the Magnoliaceæ and the Annonaceæ in the spiral structure of the flowers, but differs in the exalbuminous seed, the perigynous flowers and the opposite leaves. By some authors the family has been placed near the Rosaceæ because of the perigynous flowers, but the spiral arrangement is not that of this latter family. The aromatic bark, the magnolia-like flowers, and the peculiar rose-like fruits are distinctive.

The bark of *Calycanthus floridus* is used in America as a tonic under the name Carolina allspice.

All the species are in cultivation in the northern United States as ornamental shrubs.

81. **Annonaceæ** (from the genus *Annona*, which is from Menona, its Banda name). CUSTARD-APPLE FAMILY. Fig. 23. Trees or shrubs, with simple and entire alternate leaves: flowers usually bisexual, regular, hypogynous; sepals 3; petals usually 6, commonly valvate, rarely imbricated; stamens spirally arranged; numerous; carpels usually numerous and separate (united in Monodora), 1- to several-ovuled: fruit berry-like, rarely capsular, often constricted between the seeds.

From 500–600 species in 46 genera are found mostly in the tropical regions of Asia, Africa and America, the majority occurring in the Old World. Only



23. ANNONACEÆ: 1. Asimina; *a*, flower; *b*, floral diagram. 2. Annona, fruit. MYRISTICACEÆ: 3. Myristica; *a*, male flower; *b*, female flower; *c*, seed with arillus. MONIMIACEÆ: 4. Monimia; *a*, male flower; *b*, female flower. LAURACEÆ: 5. Cinnamomum; *a*, flower; *b*, floral diagram. 6. Benzoin, female flower.

the genus Asimina is extra-tropical in Atlantic North America and in Australia. The family is most closely related to the Magnoliaceæ; but also to the Myristicaceæ, Menispermaceæ, Calycanthaceæ and Dilleniaceæ. The plan of 3 in calyx and corolla, the numerous spiral stamens, the usually separate carpels, the berry-like fruit and ruminate endosperm are distinctive. There is great structural diversity in the family.

The Annonaceæ is rich in useful plants. The Malayans use the bark of several species for rheumatic pains, and the fruit of others as a stomachic. With the flowers of Uvaria they prepare an ointment to ward off fevers. European women in India formerly used the scented flowers of this plant in hair-oil. Many species of Annona and Asimina produce edible fruit, as for example, the sweet-sop (*Annona squamosa*), the sour-sop (*Annona muricata*), the custard-apple (*Annona reticulata*), and the northern papaw (*Asimina triloba*).

A few genera are in cultivation in America, mostly in Florida and southern California: Annona, cultivated

for the fruit; Asimina, ornamental, in the North; Artabotrys, climbing, ornamental, sweet-scented, used for perfume; Duguetia, cultivated for the fruit in Florida.

82. **Myristicaceæ** (from the genus *Myristica*, meaning an *anointing medium*, in reference to the fragrant fruit). NUTMEG FAMILY. Fig. 23. Trees or shrubs: leaves alternate, coriaceous, entire: flowers dicœcious, regular, small; perianth of one series, the 3 parts connate, 3-lobed; stamens 3–18, monadelphous; carpel 1, superior; ovary 1-celled; ovule 1; stigma sessile, entire or lobed: fruit a fleshy capsule; seed with a fleshy, laciniate aril.

The family contains 1 genus and about 80 species, of tropical distribution, principally in tropical Asia. The family is most closely related to the Annonaceæ. The dicœcious flowers with only one set of floral envelopes, and that consisting of 3 parts, the monadelphous stamens, the 1-celled, 1-ovuled ovary and the aril are distinctive.

All parts of Myristicaceæ contain a fragrant oil, which, however, is most abundant in the fruit. The seeds of *Myristica fragrans*, of the Moluccas, furnish the well-known nutmeg, used as a condiment. The aril of the same fruit is mace. The fruits of other species are also sparingly used as condiments.

Myristica fragrans is cultivated and naturalized in the West Indies.

83. **Monimiaceæ** (from the genus *Monimia*, named for the wife of Mythridates). MONIMIA FAMILY. Fig. 23. Trees or shrubs with aromatic glands: leaves opposite or whorled, rarely alternate: flowers usually bisexual, regular, perigynous, the more or less cup-shaped receptacle conspicuous, variously formed; perianth of 1 or 2 whorls, inconspicuous; stamens numerous, rarely few, scattered over the inner face of the receptacle; anthers often opening by uplifting valves; carpels numerous, all separate, also scattered over the receptacular cup; ovaries 1-ovuled; style and stigma 1 for each carpel: fruit an achene or drupe, borne on the receptacle and sessile or pedicelled, or immersed in the fleshy often urn-shaped receptacle which becomes part of an aggregate accessory fruit and frequently completely incloses the achenes.

Contained in this family are 31 genera and about 150 species, of tropical and subtropical distribution, principally of the South Sea Islands and Australia; some, however, reach South America, Africa, and other countries. The largest genus is Siparuna, containing 60 species. The family is related to the Calycanthaceæ, as is plainly evident in the fruit. The usually enlarged receptacle, the peculiar fruit, and the 1-seeded carpels are distinctive.

The Monimiaceæ have stimulating properties. Peumus leaves are used to promote digestion, like tea and coffee. The fruits of this plant are edible, as are also those of *Laurelia sempervirens*. The wood of *Atherosperma moschatum* is much sought for shipbuilding; the bark is a substitute for tea.

Peumus (Chilean Boldo) is advertised in California; valuable for its timber, edible fruits, and ornamental qualities.

84. **Lauraceæ** (from the genus *Laurus*, the old Latin name). LAUREL FAMILY. Fig. 23. Trees or shrubs with fetid or aromatic bark: leaves alternate, rarely otherwise, simple, punctate: flowers bisexual or unisexual, regular; parts of the perianth similar, usually 6, in 2 whorls; stamens in 3–4 whorls of 3 each, perigynous or epigynous, some often staminodial and glandular; anthers opening by uplifting valves; ovary superior or very rarely inferior, 1-celled, 1-ovuled; style 1; stigma 2–3-lobed: fruit a berry, drupe, or dry, often seated on a thickened pedicel or inclosed in a hollow receptacle.

The 39 genera and about 900 species inhabit mostly tropical regions, but extend into the temperate regions. Six species are found in the northeastern United States. The largest genera are Ocotea with 200 species, and Litsea with 100 species. The family is related to the Monimiaceæ, and stands between that family and the Thymelæaceæ. The undifferentiated perianth, numerous stamens with uplifting valves, and 1-celled, 1-seeded ovary are distinctive.

The Lauraceæ are useful on account of the aromatic oil. The leaves of laurel (*Laurus nobilis*) are used for flavoring and for packing figs. Cinnamon is from the bark of *Cinnamomum zeylanicum*. *Cinnamomum Cassia* yields cassia cinnamon. The bark of the root of *Sassafras variifolium* is the sassafras of commerce. Camphor is obtained by distillation from *Cinnamomum Camphora*. The fruit of *Persea gratissima* is the avocado of South America, eaten by both men and animals. Many fragrant woods are obtained from this family, as, for example: anise wood (*Ocotea cymbarum*), bebeeru wood, greenheart (*Nectandra Rodiœi*), or clove-cassia pepper wood (*Dicypellium caryophyllatum*) so named because of the pungency of the dust, Madeira mahogany (*Persea indica*), fetid till (*Ocotea fœtens*), sweetwood (*Nectandra exaltata*), and stinkwood (*Ocotea bullata*).

Among the genera in cultivation in this country are: Benzoin (Spice Bush, Benjamin Bush, Wild Allspice, Fever Bush), native, ornamental; Cinnamomum or Camphora (Camphor Tree), introduced in Florida and California; Cinnamomum (Cinnamon, Cassia Buds), cultivated under glass; Laurus (Sweet Bay), ornamental, conservatory; Persea (Red Bay, Bull Bay, Avocado), greenhouse and South; Sassafras, native ornamental; and Umbellularia (California Laurel), ornamental, in the South and California.

Order 35. RHŒADALES

85. **Papaveraceæ** (from the genus *Papaver*, derivation obscure). POPPY FAMILY. Fig. 24. Annual or perennial herbs, or rarely shrubs, with yellow (Chelidonium), white (Papaver), or red (Sanguinaria), or rarely watery (Eschscholtzia) juice: leaves usually alternate, often crenately toothed or lobed or divided: flowers bisexual, regular; sepals 2, rarely 3; petals 4, rarely 6 or more, rarely wanting; stamens numerous in many whorls, hypogynous; carpels 1 to many, connate into a 1-celled ovary, with the parietal placentæ as many as the stigmas; ovules 1 to many; styles as many as the carpels, usually wanting; stigmas distinct, or in a radiate disk, or lobed: fruit capsular or siliquose; seed albuminous.

The 23 genera and about 80 species are widely distributed in the north temperate zone, but are especially numerous in central and eastern Asia, the Mediterranean region and western North America. One species of poppy is found in the south temperate region in South Africa and Australia. The family is closely related to the Fumariaceæ (which see), with which it is united by many European authors. It is also related to Capparidaceæ and Cruciferæ. There is, on the other hand, an affinity with the Berberidaceæ. The milky juice, numerical plan of 2 or 3 in the perianth, numerous stamens, and 1-celled ovary with parietal placentæ are characteristic.

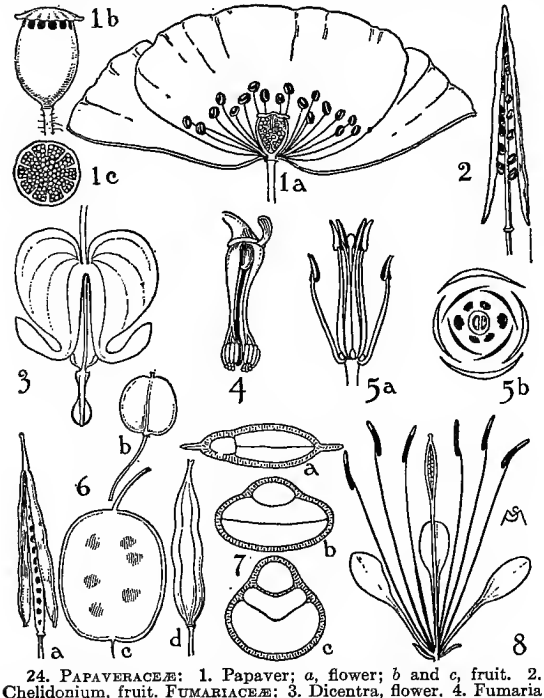
In Papaver, an orbicular disk crowns the ovary on the top of which radiate the numerous stigmatic lines. The capsules open by means of small valves between the placentæ and underneath the disk. The capsule of Chelidonium is like a mustard fruit (silique), in being long and slender and the lateral walls springing upward as valves, leaving the placentæ exposed.

Many of the Papaveraceæ are cultivated as ornamental plants. Some poppies are bad weeds in cultivated ground in Europe. *Papaver somniferum*, a native of Asia, furnishes the opium of commerce, which is obtained by incisions made in the capsules. Poppy oil is derived in France from the seeds of *Papaver somniferum*. Sanguinaria root is used in medicine as a sedative.

A score of genera are in cultivation in America, all as garden plants. Some of these are: Bocconia (Plume Poppy of eastern Asia); Chelidonium (Celandine), a weed from Europe; Dendromecon, shrubby; Eschscholtzia (California Poppy); Mecanopsis (Welsh Poppy of western Europe); Papaver (Poppy); Platystemon (Cream Cups); Platystigma; Sanguinaria (Bloodroot), native; Stylophorum (Celandine Poppy), native.

86. **Fumariaceæ** (from the genus *Fumaria*, which is from the Latin *fumus*, smoke, presumably referring to the nitrous odor of the roots when pulled from the ground). FUMITORY FAMILY. Fig. 24. Herbaceous plants with alternate, dissected leaves: flowers bisexual, regular or irregular, hypogynous; sepals 2; petals 4, free or connate, in 2 unlike pairs, outer pair larger, either one or both petals of which are spurred or gibbous, the two inner crested and united over the anthers and stamens; anthers 6, borne on 2 filaments; carpels 2, united; ovary 1-celled, 1- to many-seeded: fruit a silique, vesicular or indehiscent, or transversely jointed; seeds albuminous.

There are 5 genera and 130 species, mostly from the north temperate regions. The family is closely related to the Papaveraceæ with which it is often united. The



24. PAPAVERACEÆ: 1. Papaver; *a*, flower; *b* and *c*, fruit. 2. Chelidonium, fruit. FUMARIACEÆ: 3. Dicentra, flower. 4. Fumaria flower 1, corolla removed. CRUCIFERÆ: 5. Flower; *a*, perianth removed; *b*, floral diagram. 6. Fruit; *a*, Brassica; *b*, Lepidium; *c*, Lunaria; *d*, Raphanus. 7. Cross-section seeds of Cruciferæ, showing types of embryos; *a*, accumbent; *b*, incumbent; *c*, conduplicate. CAPPARIDACEÆ: 8. Cleome, flower.

bleeding-heart-like flower, the plan of 2, the 6 anthers on 2 filaments, the 1-celled ovary, and the absence of milky juice are distinctive.

Fumaria officinalis and some species of Corydalis have been used as medicine, but the family is of little economic importance, except for the few ornamental species.

Following are the genera best known in cultivation: Adlumia (Allegheny Vine, Climbing Fumitory), a graceful native garden climber; Corydalis, with 1-spurred corolla; Dicentra (Bleeding Heart, Squirrel Corn, Dutchman's Breeches), with 2-spurred corolla; and Fumaria (Fumitory), with 1-spurred corolla.

87. **Cruciferæ** (from the Latin signifying *cross-bearers*, in reference to the cross-like appearance produced by the four petals). MUSTARD FAMILY. Fig. 24. Herbs, rarely shrubby: leaves usually alternate, simple, often varying from entire to palmate or pinnatifid within the same genus: flowers bisexual, regular; sepals 4; petals 4, rarely wanting; stamens 6, 4 long and 2 shorter (tetradynamous), rarely fewer, very rarely more, hypogynous; carpels 2, united, ovary superior, 2-, rarely 1-, celled with 2 parietal placentæ at the edges of the septum: fruit a silique (long), or a silicle (short), rarely indehiscent; seeds exalbuminous; the embryo variously curved and folded.

In the family are 208 genera and 1,600 species, distributed throughout the cold and temperate parts of both hemispheres, but especially abundant around the Mediterranean Sea; a few are tropical. The Cruciferæ are closely related to the Capparidaceæ, Papaveraceæ, and Fumariaceæ. The 4 sepals, 4 petals, 6 stamens (4 long and 2 short), and the peculiar fruit are distinctive.

The 6 stamens probably represent a reduction from 2 sets of 4 each. In Lepidium and other genera, there may be only 2 stamens. The septum of the fruit remains upon the plant when the seeds and valves fall. The silicles are often flattened, either perpendicular or parallel to the partition (in different genera). The embryos in the seed are folded so that the hypocotyl (radicle) and cotyledons lie side by side. Distinct patterns are thus produced which are so constant as to be of great value in the classification within the family. Three principal types are recognized: cotyledons accumbent, when the edges of the cotyledons are applied to the hypocotyl; incumbent, when the back of one cotyledon is applied to the hypocotyl; and conduplicate, when the cotyledons themselves are also folded and enwrap the hypocotyl. In Leavenworthia, alone, the embryo is straight.

The flower of Cruciferæ is of little value in classification within the family; the important characters are in connection with the fruit and seeds.

Many have become well-known weeds as, for example, charlock (*Brassica arvensis*), shepherd's purse (*Capsella Bursa-pastoris*), pepper grass (Lepidium), spring mustard (Barbarea), wild radish (*Raphanus Raphanistrum*). Many others are among the well-known old-fashioned ornamental plants of the garden, e.g., rocket (*Hesperis matronalis*), stock or gilliflower (Matthiola), wallflower (Cheiranthus), honesty (Lunaria) with large orbicular flat pods, candytuft (Iberis), sweet alyssum (Alyssum). Others are used as food, of which *Brassica oleracea*, a very variable species, is the most important, furnishing cabbage, cauliflower, kohlrabi and kale. *Brassica campestris* furnishes the various forms of rutabaga. *Brassica alba* furnishes white mustard, and *Brassica nigra*, black mustard. *Radicula Nasturtium-aquaticum* is water-cress; *Radicula Armoracia* is horse-radish. The rootstocks of Dentaria are eaten in America under the name "crinkle root." *Raphanus sativus* is the garden radish; *Lepidium sativum* is garden cress. The various organs of most Cruciferæ contain an oily substance which is very pungent to the taste and which gives the peculiar flavor to the various cresses. This oil is abundant in the seeds from which it is extracted (oil of mustard). The foliage of the various maritime Cruciferæ have been found a useful article of diet in counteracting scurvy, for which reason the arctic Cochlearia is called "scurvy-grass." The leaves of the woad of western Europe (*Isatis tinctoria*) yield a blue dye. *Anastatica Hierochuntica* is the original "rose of Jericho," the branches of which close and open when alternately dried and wetted. (See article on Resurrection Plants.)

88. **Capparidaceæ** (from the genus *Capparis*, the Greek name, from the Arabic *kapar*, capers). CAPER FAMILY. Fig. 24. Herbs or rarely shrubs: flowers bisex-

ual, more or less irregular; sepals 3–8, usually 4; petals 4–8, rarely 0, hypogynous or perigynous; disk ring-like or scale-like or tubular at the base of the petals; stamens 6, rarely 4 or many; carpels 2 or more; ovary 1- to several-celled, usually raised on an outgrowth (gynophore) of the pedicel-like axis, which may become much elongated in fruit; ovules numerous; style 1 or 0; stigmas 1 to several: fruit a capsule, silique, berry or drupe; embryo usually coiled.

Thirty-four genera and about 350 species occur, mostly of tropical and subtropical distribution. They extend to Australia, the African deserts and into the western and eastern United States. The family is very closely related to the Cruciferæ and certain forms are difficult to distinguish from that family. The nontetradynamous stamens, and commonly 1-celled ovary are distinctive. The gynophore is often very long, slender and conspicuous, and sometimes (Gynandropsis) carries up the stamens along with the pistil. The detailed variation in the flower is very intricate.

Several genera are cultivated as ornamental plants. The acrid oil in the fruit is stimulating, as in the Cruciferæ, and for this reason several genera have been used in medicine (Cleome, Polanisia, Capparis, etc). *Capparis spinosa* of the Mediterranean region furnishes the capers of commerce, which are flower-buds preserved in salt and vinegar.

As garden plants, a few genera are in the American trade: Cleome (Bee or Spider Plant), ornamental; Gynandropsis, ornamental; Capparis (Caper Plant), shrubby, grown in this country for ornament as well as for food; and Cratæva, shrubby, grown in southern California.

89. **Resedaceæ** (from the genus *Reseda* which is from the Latin, *to calm*, in allusion to supposed quieting properties). MIGNONETTE FAMILY. Herbs or shrubs: leaves usually alternate: flowers mostly bisexual, more or less irregular; calyx persistent, 4–8-parted, irregular; petals 0–8, alternating with the sepals; stamens 3–40, inserted within an irregular fleshy disk; carpels 2–6, free, or united into a 1-celled ovary which is often imperfectly closed at the top; placentæ 2–6, parietal; ovules many; styles or sessile stigmas 3–6: fruit usually a dehiscent capsule, rarely a berry, or composed of separate follicles; seeds reniform, without endosperm; embryo curved.

About 45 species and 6 genera occur, mainly distributed about the Mediterranean Sea. This family is allied to the Cruciferæ and Capparidaceæ, from which it differs principally in general character. The extrastaminal disk, the numerous stamens, the 1-celled ovary or ovaries with parietal placentæ, and the usually gaping summit of the ovary are distinctive.

Reseda Luteola (Dyer's weed) yields a yellow dye which was formerly much used. *R. odorata* (mignonette), a plant cultivated since early times, and whose origin was long considered unknown, although probably Egyptian, is extensively cultivated for the fragrance of its flowers.

90. **Moringaceæ** (from the genus *Moringa*, derived from the Malabar name of the plant). MORINGA FAMILY. Trees, with 2–3-pinnate alternate leaves: flowers bisexual, irregular, perigynous; sepals 5, imbricated; petals 5, imbricated, unequal, lower reflexed; stamens 8–10, separate or united at the base, alternate ones shorter or reduced to staminodia; subovarian disk present, lining the cup; ovary borne on a gynophore, 1-celled; placentæ 3; ovules numerous; style 1: fruit a silique-like capsule.

There is but one genus, containing 3 species, natives of northeastern Africa and India. The family is distinct, not related closely to any other, perhaps distantly related to the Bignoniaceæ, the Capparidaceæ, the Violaceæ, or the Leguminoseæ. Provisionally placed by Engler and Prantl between the Poppy group of families and the Rose group.

Moringa arabica of Arabia (ben-nut) yields a useful oil which does not become rancid. The root of one species is used in intermittent fevers. A tragacanth-like gum exudes from the bark of *M. oleifera*.

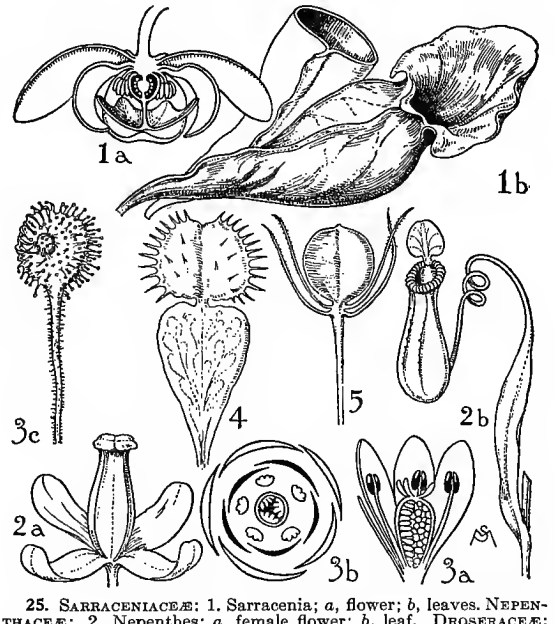
M. oleifera (horse-radish tree) is grown sparingly in the southern United States. The fruits and the roots are edible.

Order 36. SARRACENIALES

91. **Sarraceniaceæ** (from the genus *Sarracenia*, in honor of Dr. Sarracin, an early physician of Quebec, who sent the northern species to Europe). PITCHER-PLANT FAMILY. Fig. 25. Perennial herbs inhabiting bogs: leaves all basal, tubular: scapes 1-flowered; flowers bisexual, regular; sepals 4–5, imbricated; petals 5, hypogynous, or 0; stamens many but not apparently either cyclic or spiral; ovary superior, 3–5-, rarely 6-, celled; ovules numerous; style 1; stigmas 1–5: fruit a capsule.

The Sarraceniaceæ has 3 genera and 8 species, of which 6 belong to the genus Sarracenia; all American. Heliamphora is in British Guiana, Darlingtonia in California, and Sarracenia in Atlantic North America from Newfoundland to Florida. The family is most closely related to the Droseraceæ and Nepenthaceæ, but also to the Papaveraceæ and Nymphæaceæ.

The Sarraceniaceæ are far-famed as insectivorous plants. The pitchers are partly filled with a liquid containing a digestive enzyme. Small insects which fall into the liquid, or are attracted by a sugary secretion, and are unable to escape because of various devices, are at length digested and absorbed. Like the sundews, these plants can inhabit soils poor in nitrates. The remarkable umbrella-shaped style, and fiddle-shaped petals of Sarracenia are part of a very interesting mechanism for cross-pollination.

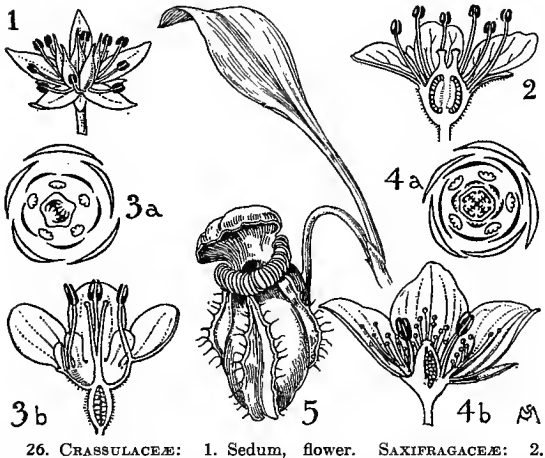


25. SARRACENIACEÆ: 1. Sarracenia; *a*, flower; *b*, leaves. NEPENTHACEÆ: 2. Nepenthes; *a*, female flower; *b*, leaf. DROSERACEÆ: 3. Drosera; *a*, flower; *b*, floral diagram.; *c*, leaf. 4. Dionæa, leaf. 5. Aldrovanda, leaf.

The family is of little economic importance. The rhizome of *Sarracenia purpurea* was used in Canada as a specific against smallpox, but did not prove of value. *Darlingtonia californica* and species of Sarracenia are in the trade because of their peculiar habits and structure, and their botanical interest. They are grown mainly in the greenhouse.

92. **Nepenthaceæ** (from the genus *Nepenthes*, derived from the Greek signifying a *magic potion*, probably in reference to the pitchers). NEPENTHES FAMILY. Fig. 25. Slightly woody or herbaceous plants: leaves alternate, consisting of a winged basal portion, a slender stalk-like intermediate portion, and a terminal urn-shaped pitcher with a rolling fluted border and a lid, the pitcher containing a watery fluid: flowers diœcious, paniculate, regular; perianth of 4 parts, possibly 2 sepals and 2 petals, imbricated; stamens 4–16, monadelphous; ovary superior, 3–4-celled; ovules numerous in each cell; stigma sessile, discoid: fruit a capsule.

A single genus with about 40 species occurs in the East Indies, Madagascar, the Seychelle Islands, and New Caledonia. Borneo has the greatest number of species. The family is related to the Sarraceniaceæ and Droseraceæ, although formerly considered related to the Aristolochiaceæ. The habit, the undifferentiated perianth, the monadelphous stamens, and the 3–4-celled ovary, are distinctive. A remarkable family of insectivorous plants. Along with the water secreted in the cavity of the pitcher is a pepsin-like substance, by the aid of which insects are digested, the dissolved material being later absorbed. The slender part of the leaf in some species coils and serves as a tendril by means of which the plant climbs.



26. CRASSULACEÆ: 1. Sedum, flower. SAXIFRAGACEÆ: 2. Saxifraga, flower. 3. Ribes, *a*, floral diagram; *b*, flower. 4. Parnassia, *a*, floral diagram; *b*, flower. CEPHALOTACEÆ: 5. Cephalotus, leaves.

In American greenhouses, many kinds of Nepenthes (Pitcher Plants), some of hybrid origin, are cultivated because of their curious habit.

93. **Droseraceæ** (from the genus *Drosera*, derived from the Greek, meaning *dewy*). SUNDEW FAMILY. Fig. 25. Very glandular herbs or sub-shrubs with alternate leaves: flowers bisexual, regular, hypogynous, rarely perigynous; sepals 4–5, imbricated; petals 5, imbricated; stamens in 1 or more whorls of 5; carpels 2–5; ovary superior, 1–3-celled: fruit a capsule with numerous seeds.

The 6 genera and about 100 species, 90 species of which belong to the genus Drosera, are widely scattered over the earth. The family is related in floral structure to the Cistaceæ and Violaceæ, and to the Saxifragaceæ.

The Droseraceæ are noted as insectivorous plants. Drosera has a rosette of small basal leaves covered with sensitive motile tentacles that secrete a terminal drop of clear sticky fluid, the so-called dew, in which small insects are caught as on sticky fly-paper. A digestive substance is then secreted and the organic matter absorbed. The leaves of Dionæa (the famous Venus' fly-trap of Carolina) have a conduplicate terminal lobe which closes violently when a fly alights upon the upper (inner) surface. A marginal fringe prevents the escape of the insect; and it is in time digested. Aldrovanda of South Europe has tiny traps similar to those of Dionæa, but the whole plant is aquatic, and resembles Utricularia.

Drosophyllum and Roridula are said to be used in Portugal and the Cape for the practical capture of flies in the house. The leaves of some Droseras yield a purple dye. The liquids known as aqua-auri and rosoglio (Italian) contain *Drosera rotundifolia* as an essential ingredient.

Drosera and Dionæa are in the American trade, mostly grown as greenhouse curiosities.

Order 37. ROSALES

94. **Crassulaceæ** (from the genus *Crassula*, diminutive of *crassus*, meaning thick). ORPINE FAMILY. Fig. 26. Herbs or sub-shrubs: leaves mostly alternate, commonly fleshy: flowers mostly bisexual, regular; sepals 5, rarely 3–30, imbricated; petals as many, rarely connate; stamens as many or twice as many as the petals, epipetalous or hypogynous, rarely perigynous, separate; carpels as many as the petals, separate with a scale at the base of each; ovules numerous, rarely few or one: fruit a group of follicles, rarely the carpels somewhat united and ovary half-inferior.

Thirteen genera and about 500 species inhabit the drier parts of the earth, but principally South Africa and South Europe. The genus Sedum contains 140 species, and Crassula 120 species. This is a very definite family, but closely related to the Saxifragaceæ, from which it differs in the regular numerical plan, almost constantly separate ovaries, and predominatingly fleshy habit.

The Crassulaceæ are well adapted to a dry climate. The fleshy leaves are provided with water-storage tissue and a thick cuticle, and are often odd in shape and appearance. These leaves lose water very slowly when separated from the plant, and will often remain fresh for weeks. When pinned to the wall, the leaf of Bryophyllum sends forth plantlets from the margin, and the stem of live-forever may grow and flower, so efficient is the protection against loss of water afforded by the cuticle. These plants, likewise, will grow for weeks or months in the collector's press.

The herbage contains much tannin and sometimes acid. A refreshing drink has been made from *Sempervivum tectorum* (houseleek). The fleshy leaves of the Crassulaceæ are cooling to wounds and burns. *Sedum Telephium* was formerly cultivated as a pot-herb. Other species have been used for nearly similar purposes.

Several genera are in cultivation in America. Of these, Sempervivum is the well-known Houseleek or Old-hen-and-chickens; Cotyledon is somewhat similar in growth; *Sedum acre* is Moss Stonecrop; and *Sedum triphyllum* (*S. Telephium*) is Live-forever, or Orpine.

95. Cephalotaceæ (from the genus *Celphalotus*, derived from the Greek meaning *headed*, said to refer to the capitate hairs at the base of the flower). CEPHALOTUS FAMILY. Fig. 26. Perennial scapose herbs: leaves of 2 kinds in a basal rosette, one lanceolate and ordinary, the other a petioled pitcher with winged sides, fluted mouth and a lid: flowers bisexual, regular, perigynous; perianth of 6 parts, apparently in one series, valvate; stamens 12, in 2 whorls; carpels 6, separate, arranged around the woody apex of the axis; 1–2 basal ovules in each: fruit dry, somewhat inflated.

The family consists of but 1 genus and 1 species (*Cephalotus follicularis*), found in the swamps of King George's Sound, West Australia. This family is related to the Saxifragaceæ, and was formerly united with that family, but differs in the peculiar habit, the wholly separate carpels arranged around the apex of the axis,

and the basal seeds; related also to the Crassulaceæ, but lacks the hypogynous scales and has basal seeds.

This remarkable little insectivorous plant is cultivated in greenhouses as a curiosity.

96. **Saxifragaceæ** (from the genus *Saxifraga*, derived from the Latin signifying to *break rocks*, in allusion to the habit of growing in the clefts of rocks). SAXIFRAGE FAMILY. Fig. 26. Herbs, shrubs, or small trees: leaves alternate, rarely opposite: flowers bisexual, usually regular, hypogynous or perigynous, rarely epigynous; sepals 4–5, rarely more or fewer; petals usually of the same number, valvate or imbricated, inserted with the stamens at the edge of a receptacular nectariferous disk; stamens of the same number as the petals and alternate with them, or twice as many and the outer opposite the petals; carpels 2, rarely 5, partly united, rarely separate, superior or half inferior; ovules numerous; styles and stigmas as many as the carpels: fruit a capsule or berry.

There are about 70 genera and some 700 species, widely distributed but more abundant in temperate regions. Many reach the arctics. Some are fossil. Saxifraga is the largest genus, with 200 species in the north temperate, arctic and Andean regions. Ribes has 50 species. The family is closely related to the Rosaceæ, differing in the more abundant endosperm and constantly few carpels and few stamens; related also to the Crassulaceæ, which has a regular numerical plan and hypogynous scales; and to the Cunoniaceæ and Hamamelidaceæ.

The ovaries of Ribes, Philadelphus, Chrysosplenium, Deutzia, Hydrangea, and some Saxifragas, and a few other genera are almost wholly inferior. Parnassia has staminodia in clusters at the base of each petal. The fruit of Ribes is a berry. Some Heucheras have irregular flowers; also some Saxifragas, some Hydrangeas and Tolmieas. The peripheral flowers of Hydrangea often have enlarged corollas and are sterile. Waterglands in the axils of the foliar teeth of some Saxifragas secrete a deposit of lime.

The rough leaves of *Deutzia scabra* are used in Japan to polish wood. The fruits of several species of Ribes are edible; *R. vulgare* yields the red currant; *R. Grossularia*, the English gooseberry, and also native gooseberries; *R. nigrum*, the black currant. Otherwise the family is of economic importance only for its ornamental species, which are numerous and largely hardy.

Many genera are in cultivation in this country. Among these the following well-known names may be noted: Deutzia; Decumaria, climbing shrub; Golden Saxifrage (Chrysosplenium); Astilbe; Hydrangea; Mock-orange or Syringa (Philadelphus); Currants and Gooseberries (Ribes); False Mitrewort or False Bishop's-cap or Foam-flower (Tiarella); Grass of Parnassus (Parnassia); Mitrewort or Bishop's-cap (Mitella); Alum Root or Coral Bells (Heuchera); Saxifrage and Strawberry Geranium (Saxifraga).

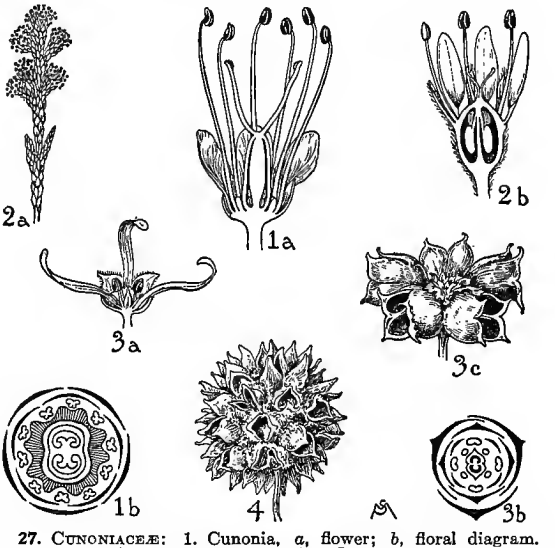
97. **Pittosporaceæ** (from the genus *Pittosporum*, the name referring to the viscid coating of the seeds). PITTOSPORUM FAMILY. Trees or shrubs, often climbing: leaves alternate, mostly leathery: flowers bisexual, regular; sepals or divisions of the calyx 5, imbricated; petals 5, imbricated in the bud; claws often connivent or coherent; stamens 5, alternating with the petals, hypogynous, no disk at the base; carpels 2, rarely 3–5; ovary 1- to several-celled; placentæ parietal or axial; style 1; stigmas 1 to several: fruit a capsule or berry; seeds numerous or few, immersed in a pulp or viscid juice.

All the 9 genera and about 90 species are natives of Australia, except the genus Pittosporum, which, however, is of the Old World. The largest genus is Pittosporum containing 70 species. The relationship of the family is doubtful. Though in the past supposed by different authors to be related to the Celastraceæ, Polygalaceæ, Caryophyllaceæ, Rutaceæ, Saxifragaceæ, Ericaceæ, and so on, it is, according to Pax, most closely related to the Saxifragaceæ.

The Pittosporaceæ all contain resinous aromatic bitter material in organized resin-canals or chambers. These give the fruit a disagreeable flavor. In spite of this disagreeable taste, it is said (Lemaout and Decaine) that, "The natives of Australia, who to appease their hunger are reduced to filling their stomachs with clay mixed with organic detritus, eagerly devour the fleshy fruits of this family."

Most of the genera are in cultivation: Bellardiera; Bursaria, a spiny shrub; Hymenosporum, a shrub with yellow flowers; Pittosporum (Pittosporum, Karo, Tawhiwhi, Tarata, Tobira), evergreen, fragrant shrubs; Sollya (Australian Bluebell Creeper).

98. **Cunoniaceæ** (from the genus *Cunonia*, named after John Christian Cuno, an Amsterdam botanist of the 18th century). CUNONIA FAMILY. Fig. 27. Trees or shrubs: leaves opposite or whorled, simple, ternate or pinnate: flowers small, densely crowded, usually bisexual, hypogynous; sepals 4–5, rarely 6, usually valvate; petals 4–5, small, usually wanting; stamens twice as many as the sepals, rarely just as many or more numerous, exserted, attached near the edge of an intrastaminal disk; ovary mostly 2-celled, superior; ovules numerous, rarely few; styles 1–2; stigmas 2: fruit usually a capsule, rarely a drupe or nut.



27. CUNONIACEÆ: 1. Cunonia, *a*, flower; *b*, floral diagram. BRUNIACEÆ: 2. Brunia, *a*, flower branch; *b*, flower. HAMAMELIDACEÆ: 3. Hamamelis, *a*, flower; *b*, floral diagram; *c*, fruit. 4. Liquidambar, fruit.

Nineteen genera and 120 species are known, 70 species of which belong to Weinmannia; all of South America or the Australian region, except one in South Africa.

The family is closely related to the Saxifragaceæ, with which it was formerly united, but because of the uniform floral structure and the position of the leaves, as well as the geographical distribution, it is now treated as distinct.

The wood of some species is useful; otherwise the Cunoniaceæ are of little economic importance. *Acrophyllum venosum*, an Australian evergreen shrub, is cultivated in greenhouses.

99. **Bruniaceæ** (from the genus *Brunia*, named in honor of Cornelius Brun, a traveler in the East). BRUNIA FAMILY. Fig. 27. Heath-like shrubs: leaves alternate: flowers bisexual, regular, epigynous; sepals 4–5, imbricated; petals 4–5, imbricated; stamens 4–5,

alternating with the petals, free or united with the petals, or with each other; rarely an intrastaminal disk present; ovary inferior, 1–3-celled; ovules 1–2 in each cell: fruit dry, indehiscent, or capsular.

Twelve genera and about 50 species occur, all natives of South Africa. The family is related to various families of the Saxifrage group, as, for instance, the Hamamelidaceæ, but is distinct because of its heath-like habit. The flowers are mostly in dense heads.

The family is of no economic importance. One species of Audouinia (*A. capitata*) is said to be sometimes in cultivation as *Diosma capitata*.

100. **Hamamelidaceæ** (from the genus *Hamamelis*, an ancient Greek name applied to some tree). WITCH-HAZEL FAMILY. Fig. 27. Trees or shrubs: leaves simple, alternate: flowers unisexual or bisexual, hypogynous, perigynous or epigynous; sepals 4–5; petals 4–5, or 0; stamens 4–5, rarely more; sub-ovarian disk rare; ovary 2-celled; ovules 1 or several in each cell: fruit a woody, 2-valved capsule, with a separating inner layer of different texture; seeds often winged.

Twenty genera and 50 species are known, widely distributed in subtropical or warm temperate regions of both hemispheres. It is an ancient family more abundant in former ages, related to the Saxifragaceæ, and by some considered related to the Cornaceæ or Araliaceæ. Many fossil species are known. The peculiar fruit is distinctive.

In some genera, as in Hamamelis, the seeds are forcibly expelled when the fruit opens, often to a distance of 10 feet or more, much as wet apple seeds may be shot from between the thumb and finger.

The family is of little economic importance. Extract of the bark of Hamamelis is used as a liniment (witch-hazel). The twigs are supposed to have supernormal properties, especially in the detection of water in the earth. They are frequently used in rural districts in the attempt to detect underground springs. *Liquidambar Styraciflua* (sweet gum), of the southern United States, yields a balsam. The oriental balsam, Styrax, is obtained from the eastern *L. orientalis*. This was formerly used in medicine.

Perhaps half the genera are in cultivation, all for ornamental purposes. Of these, Fothergilla, Corylopsis Hamamelis, and Liquidambar are the best known. Most of the species are hardy.

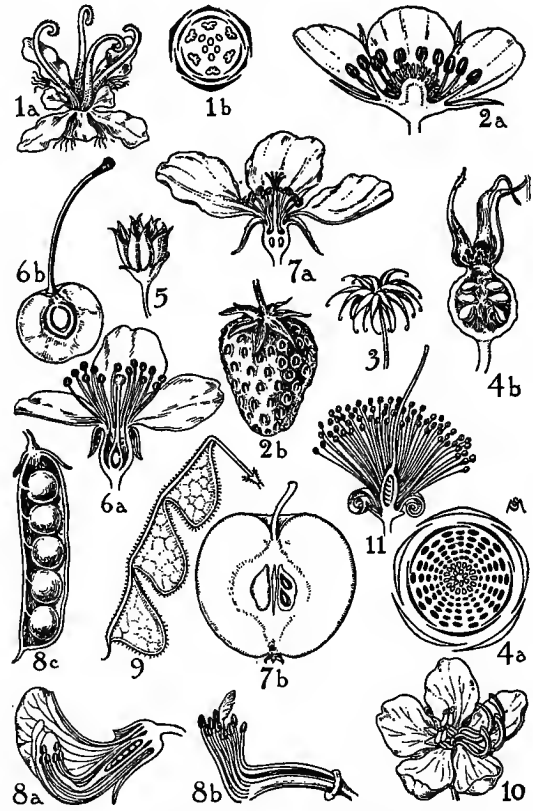
101. **Platanaceæ** (from the genus *Platanus*, the ancient name of the tree, signifying *broad*). PLANE-TREE FAMILY. Fig. 28. Trees with alternate, broad, palmately veined leaves: flowers in dense heads, monœcious, regular, perigynous; sepals usually 3–8, separate, thick, often with bracts at the base; petals of the same number, glabrous; stamens of like number alternating with the petals; connective peltate at the top; extra staminodia often present; carpels several, distinct, 1-seeded: fruit a caryopsis, angled from pressure, and truncate at top, surrounded by long hairs at the base; seed orthotropous.

A single genus and about 6 species are distributed in southern Europe, southern Asia, and in North America. The family is related to the Saxifragaceæ and Hamamelidaceæ. The polypetalous perigynous flower, with as many stamens as petals, the separate carpels, and especially the peculiar inflorescence and leaf, are distinctive. Fossil species are known.

The wood of Platanus is similar to maple and of value, but the most important use is for ornament. Two species of Platanus (Plane-Tree, Buttonwood, Button Ball, Oriental Plane, Sycamore) are in cultivation in America.

102. **Rosaceæ** (from the genus *Rosa*, the ancient name of the rose). ROSE FAMILY. Fig. 28. Herbs, shrubs, or trees, often thorny, sometimes climbing: leaves alternate, rarely opposite: flowers bisexual, rarely unisexual, usually regular, perigynous; calyx of 4–5 imbricated or valvate sepals; corolla of as many imbricated petals, or 0; stamens 5 to many, in whorls of 5, borne on the cup of the receptacle at some distance from the carpels; cup lined with a glandular disk; carpels 1 to many, separate and superior or united and inferior; ovaries 1 to several-ovuled; styles as many as the carpels: fruit a follicle, achene, drupe, pome, or hip; seeds usually exalbuminous.

There are about 90 genera and 1,500 species, widely distributed in all parts of the world, most abundant, perhaps, in the temperate regions. The largest genera are Rubus, 180–200 species; Potentilla, 200 species; and Rosa, 100 species. The family is related to the Saxifragaceæ and the Leguminosæ, also to the Calycanthaceæ. The perigynous flower with cup lined by the glandular disk, the numerous cyclic stamens, and



28. PLATANACEÆ: 1. Platanus, *a*, flower; *b*, floral diagram. ROSACEÆ: 2. Fragaria, *a*, flower; *b*, fruit. 3. Geum, fruit. 4. Rosa, *a*, floral diagram; *b*, fruit. 5. Spiræa, fruit. 6. Prunus, *a*, flower; *b*, fruit. 7. Pyrus, *a*, flower; *b*, fruit. LEGUMINOSÆ: 8. Pisum, *a*, flower; *b*, flower, petals removed; *c*, fruit. 9. Desmodium, fruit. 10. Cassia, flower. 11. Acacia, flower.

the separate, usually cyclic, carpels, are distinctive. The Ranunculaceæ is similar, but acyclic and hypogynous.

The family is divided into 6 very distinct subfamilies, some of which, by certain authors, are considered of family rank, as follows: I. Fruit follicular, e.g., Spiræa, Physocarpus, Aruncus, Sorbaria, and so on. II. Ovary compound, inferior: fruit fleshy, e. g., Pyrus, Cratægus, Cotoneaster, Cydonia, Amelanchier, Mespilus, and the like. III. Fruit of achenes or separate drupelets, e.g., Rubus, Fragaria, Potentilla, Geum, Cercocarpus, Ulmaria, Alchemilla, Agrimonia, Sanguisorba, and Rosa. IV. Carpels connate, and adnate to the hollow, but dry, receptacle, e.g., Neurada and Grielum. V. Carpel 1, superior: fruit a drupe: style terminal, e.g., Prunus. VI. Same as the last, but

style basal and flowers often irregular, e.g., Chrysobalanus.

The fruitlets of Rubus have a fleshy ovarian wall and are drupelets. The strawberry has a fleshy receptacle with dry achenes scattered upon it. The rose fruit consists of a hollow, fleshy receptacle bearing achenes on its inner face; that of Pyrus is similar, but the receptacle and carpels have grown together into one structure. The peach, cherry, and plum are each the product of one superior carpel.

The following plants are cultivated for their fruits: apple, pear, quince, cherry, plum, apricot, peach, almond, raspberry, blackberry, strawberry, and medlar. These fruits are eaten fresh, preserved in sugar, or fermented into vinegar or cider. Rose fruits are also preserved, and the fruits of mountain ash are used for making a spirituous drink. The petals of *Rosa damascena* and *R. gallica* are macerated with oil of sesame to form attar of roses. The petals themselves yield oil of rose, from which rose-water is made. Many species have been used in medicine; e.g., rose, the seeds of which are vermifugal. Quince seeds contain mucilage and are emollient. The conserve of rose is astringent. Agrimony is nephritic, and is also used for pulmonary catarrh and angina. Alchemilla is astringent and vulnerary. The root of Fragaria is diuretic and astringent. Flowers of *Hagenia abyssinica* are a famous remedy for tapeworm. Flowers of Ulmaria are used to give a bouquet to wine; also as a sudorific and cordial. The bark of *Prunus serotina* (wild cherry bark) is tonic and pectoral. The bark of *Quillaja Saponaria* (soap-bark tree) of Chile, is a stimulant, diuretic and irritant, contains saponin, and is used for washing delicate fabrics. Gummy exudations from the bark of cherry are sometimes used in medicine. Sanguisorba has been used for forage, and as a condiment. The seeds of many species of Prunus and others yield oil in quantity.

Fifty or sixty genera are cultivated in America. Among these are: Agrimonia (Agrimony); Alchemilla (Lady's Mantle); Amelanchier (Shadbush, Juneberry, Service-berry); Aronia (Choke-berry); Aruncus; Cercocarpus; Chrysobalanus (Cocoa Plum); Comarum (Marsh Cinquefoil); Cotoneaster; Cratægus (Hawthorn, Scarlet Thorn, Washington Thorn); Eriobotrya (Loquat, Japan Plum); Exochorda (Pearl Bush); Fragaria (Strawberry); Geum (Avens); Gillenia or Porteranthus (American Ipecac, Bowman's Root); Holodiscus or Schizonotus; Kerria (Globe-flower, Japanese Rose); Margyricarpus (Pearl Fruit); Mespilus (Medlar, Mespil); Neviusia (Snow Wreath); Photinia (Toyon, Tollon); Physocarpus (Ninebark); Potentilla (Cinquefoil, Five-finger, Silver-weed); Pyracantha; Pyrus (Pear, Apple, Crab); Quillaja (Soap-bark Tree); Raphiolepis (Indian Hawthorn); Rosa (Rose, Eglantine, Sweetbrier); Rubus (Bramble, Blackberry, Raspberry, Cloudberry, Baked-apple Berry, Yellow Berry, Salmonberry, Wineberry, Blackcap, Thimbleberry, Dewberry); Sanguisorba (Burret); Sorbaria; Sorbus, (Mountain Ash, Rowan Tree, Dogberry, Service Tree, White Beam-tree); Spiræa (Queen of the Meadows, Meadowsweet, Hardhack, Steeple-bush, Bridal Wreath); Ulmaria (Meadowsweet, Queen-of-the-Prairie, Queen-of-the-Meadows); Waldsteinia (Barren Strawberry, Yellow Strawberry).

103. **Leguminosæ** (from *legume*, the name of the type of fruit characteristic of this family). PEA FAMILY. Fig. 28. Herbs, shrubs, or trees, often twining: leaves alternate, compound, rarely simple: flowers regular or irregular, usually bisexual, hypogynous or perigynous, fundamentally polypetalous; sepals 5, more or less connate, often unequal; petals 5, rarely fewer, nearly equal, or unequal, or more commonly papilionaceous (i. e., 1 dorsal standard, 2 lateral cleaver-shaped wings, and 2 ventral, more or less connate, petals forming the keel); stamens 10 or very numerous, rarely 5, included or exserted, often inserted around a glandular disk, monadelphous, 9 united and 1 separate, or all separate; carpel 1, rarely 2–15, superior; ovary 1-celled, inequilateral; the single parietal placenta ventral but turned dorsally; ovules 1 to many: fruit a legume, or, by reduction, indehiscent, or follicular, or fleshy, often jointed between the seeds, and sometimes filled with pulp; seeds exalbuminous.

Leguminosæ contains 429 genera and about 7,000 species, distributed over the whole earth, but most abundant in the tropics. This family and the Orchidaceæ are, next to the Compositæ, the largest families of flowering plants. The large genera which contain 100 or more species are: Astragalus, 1,200 species; Acacia, 450 sp.; Cassia, 380 sp.; Mimosa, 300 sp.; Crotolaria, 250 sp.; Indigofera, 250 sp.; Trifolium, 250 sp.; Bauhinia, 150 sp.; Aspalanthus, 150 sp.; Oxytropus, 150 sp.; Desmodium, 150 sp.; Inga, 140 sp.; Tephrosia, 120 sp.; Vicia, 120 sp.; Pithecolobium, 110 sp.; Lupinus, 100 sp.; Psoralea, 100 sp.; Dalea, 100 sp.; Lathyrus, 100 sp.; Rhynchosia, 100 sp.; and Phaseolus, 100 sp. Taken in the broad sense, the family is a very natural one, the nearest relatives being the Chrysobalanus section of the Rosaceæ. The most constant distinguishing character is the leguminous type of fruit. When this occasionally varies, the papilionaceous corolla, or the general Mimosa type of flower, is distinctive. Except in the fruit, the family is very diverse, and the following sub-families have often been treated as distinct families.

Sub-family I. Mimosæ.—Flowers regular; corolla valvate; stamens 5–10, or very numerous, exserted: e.g., Pithecolobium, Albizzia, Mimosa, and Acacia.

Sub-family II. Cæsalpinæ.—Flowers irregular, not papilionaceous; stamens 10 or fewer, not conspicuously exserted; corolla imbricated: e.g., Copaiba, Tamarindus, Cercis, Bauhinia, Cassia, Gleditsia, Gymnocladus, Cæsalpinia, and the like.

Sub-family III. Papilionateæ.—Corolla papilionaceous, imbricated; stamens 5–10, included: e.g., Pisum, Lathyrus, Robinia, Vicia, Phaseolus, and so forth.

The leaves of many Leguminosæ are motile. *Mimosa pudica*, *Cassia nictitans*, and others, are sensitive to touch, the leaflets, and often the leaves, quickly drooping when disturbed. A great number show sleep movement, the leaflets drooping at nightfall. The motile organ is the pulvinus at the base of the leaflet or leaf. The lateral leaflets of *Desmodium gyrans* are rhythmically and spontaneously motile. The pollination of the papilionaceous flowers is complicated and interesting. (See Kerner and Oliver's "Natural History of Plants.") The legumes of Desmodium separate into 1-seeded joints which are covered with hooked hairs, and, therefore, bur-like. The roots of the Leguminosæ commonly bear tubercles containing nitrogen-fixing organisms, the product of which is used by the plant.

The economic plants are almost innumerable. The following are the most important:

Plants used for food: *Detarium senegalense* of Senegambia, edible drupe; *Castanospermum australe* (Australian chestnut), *Dolichos Lablab* (black bean), *Phaseolus vulgaris* (bean), *Cicer arietinum* (chick pea), *Pisum sativum* (pea), *Ervum Lens* (lentil) and Lupinus sps., all have edible seeds; *Apios tuberosa*, *Psoralea hypogæa*, and *P. esculenta*, edible tubers; *Arachis hypogæa* (peanut), and *Voandzeia subterranea*, subterranean seeds; *Lathyrus tuberosa*, sugary tubers, much used before potatoes were known; and *Cytisus scoparius*, buds used as capers.

Plants used as forage: *Ceratonia Siliqua* (St. John's bread), *Onobrychis sativa* (sainfoin), *Vicia sativa* (vetch), *Medicago sativa* (alfalfa), *Medicago lupulina* (medick), *Trifolium* species (clover), *Glycine hispida* (soy bean), *Vigna Catjang* (cowpea), *Lotus corniculatus*, Lupinus sps., *Anthyllis Vulneraria*, *Hedysarum coronarium*, *Ornithopus sativus*, *Pisum sativum*, *Ulex europæus*.

Plants used for medicine: *Acacia Senegal* (gum acacia); *A. Catechu* (catechu), astringent, tonic; *Swartzia tomentosa*, sudorific; *Copaiba Langdorfii* (balsam of Copaiba), of Brazil, for catarrh; Cassia sps., Orient, India, etc., leaves purgative; *Tamarindus indica* (tamarind), pulpy pods used; *Sophora tomentosa*, India, seeds arrest choleric vomiting; *Toluifera Balsamum* (balsam of Tolu), South America, bronchial; Andira sps., tropical America, emetic, purge, narcotic, vermifuge; *Ptcrocarpus Draco* (dragon's blood), West Indies, astringent; *P. Marsupium* (gum kino); *Butea frondosa* (eastern kino), Asia; *Mucuna pruriens* (cowitch or cowage), India, stinging hairs on pod, anthelmintic; *Astragalus gummifer* (gum tragacanth), of the Orient; *Colutea arborescens* (bladder senna), purgative, emetic; *Glycyrrhiza glabra*, (licorice), Europe, emollient; *Genista tinctoria*, purgative; *Cytisus scoparius*, diuretic; *Trigonella Fœnum-græcum* (fenugreek), Old World, food, condiment, horse-remedy, and so on; *Anagyris fœtida* (stinking wood), purgative and poisonous; *Physostigma venosum* (calabar bean), sedative, contracts the pupil, poisonous; Astragalus sps., and Crotalaria sps. are loco-weeds, and poisonous to cattle; arrow-poisons are furnished by Erythrophlœum, Afzelia, and Pithecolobium. Fifteen genera furnish fish-poison.

Dye-stuffs: *Cæsalpinia echinata* yields braziline; *Sophora japonica* yields yellow dye; *Indigofera tinctoria* yields indigo; *Genista tinctoria*, yields a dye; *Hæmatoxylon campechianum* yields logwood and hæmatoxylin. *Pterocarpus santalinum* yields red sandalwood, a brown dye.

Other purposes: Copal varnish from Hymenæa sps., Trachylobium sps., and Copaiba sps. Many species are valuable timber trees. A snuff-perfume is obtained from seeds of Coumarouna (tonka bean). Rosewood is from *Dalbergia nigra*, and other species. African rosewood is from *Pterocarpus erinaceus*. Red seeds of *Abrus precatorius* (jequirity) are used for necklaces, as are also those of *Adenanthera Pavonina* (Circassian seeds). Branches of *Cytisus scoparius* (broom) are used for basket-work. *Ulex europæus* (furze) is used as firewood in France. Many species furnish fibers for spinning. Oil is obtained from seeds of peanut and others. Many are ornamental.

About 150 genera are cultivated in America, or are important to American agriculture. Many of the species are among our most valuable ornamental and food-plants. Some of these genera are: Abrus (Crab's-eye Vine, Weather Plant); Acacia (Wattle, Kangaroo Thorn, Weeping Myall, Australian Blackwood, Mulga, Popinac, Opopanax, Cassie, Huisache, Espino, Cavan, Gum Arabic Tree); Adenanthera (Red Sandalwood); Albizzia; Alhagi (Camel's Thorn); Amphicarpæa (Hog Peanut); Amorpha (Lead Plant, Bastard Indigo); Anthyllis (Kidney Vetch, Sand Clover, Woundwort, Jupiter's Beard); Apios (Groundnut, Wild Bean); Arachis (Peanut, Goober); Astragalus (Milk Vetch); Baptisia (Wild Indigo); Bauhinia (Mountain Ebony); Cæsalpinia (Brasilleto, Barbadoes Pride, Barbadoes Flower-fence, Dwarf Poinciana); Canavalia (Jack Bean, Chickasaw Lima); Caragana (Pea Tree); Cassia (Wild Senna, Partridge Pea, Pudding Pipe Tree); Centrosema (Butterfly Pea); Cercis (Judas Tree, Red Bud); Chorizema; Cicer (Chick Pea); Cladrastis (Yellow-wood); Clianthus (Glory Pea, Glory Vine, Parrot's Bill); Clitoria (Butterfly Pea); Colutea (Bladder Senna); Coronilla (Crown Vetch, Scorpion Senna); Crotalaria (Rattle-Box); Cytisus (Broom, Genista); Desmodium (Tick Trefoil, Telegraph Plant); Dolichos (Hyacinth Bean, Taukok, Black Bean), the species still much confused; Erythrina (Coral Tree); Galega (Goat's Rue); Genista (Dyer's Greenwood); Gleditsia (Honey Locust, Sweet Locust, Three-thorned Acacia); Glycine (Soy Bean); Glycyrrhiza (Licorice); Gymnocladus (Kentucky Coffee Tree); Halimodendron (Salt Tree); Hedysarum (French Honeysuckle); Hosackia; Indigofera (Indigo); Kennedya; Laburnum (Golden Chain, Bean Tree, Scotch Laburnum); Lathyrus (Sweet Pea, Tangier Scarlet P., Pride of California, Everlasting P., Two-flowered P., Flat P., Perennial P., Lord Anson's P., Marsh P., Sea P., Beach P., Prairie Vetchling, Black P., Black Bitter Vetch, Spring Bitter Vetch); Lens (Lentil); Lespedeza (Bush Clover, Japan Clover, Hoop-koop); Leucæna (White Popinac); Lotus (Bird's-foot Trefoil, Babies' Slippers, Winged Pea); Lupinus (Lupine, Sundial, Deer Cabbage); Millettia (Ironwood); Medicago (Alfalfa, Lucerne, Black or Hop Medick, Nonesuch, Snails, Tree Alfalfa, Moon Trefoil); Melilotus (Sweet Clover); Mimosa (Sensitive Plant, Humble Plant); Mucuna (Cowitch, Cowage, Velvet Bean, Banana Bean); Onobrychis (Sainfoin, Holy Clover); Ononis (Rest-Harrow, Goat Root); Parkinsonia (Jerusalem Thorn); Parochetus (Shamrock Pea, Blue Oxalis); Petalostemon (Prairie Clover); Phaseolus (Bean, Caracol, Snail-flower, Corkscrew Flower, Scarlet-runner, Dutch Caseknife B., Metcalfe B., Moth B., Gram, Silva B., Civet B., Lima B., Kidney B., Bush B.); Piscidia (Fish-poison Tree, Jamaica Dogwood); Pisum (Garden Pea, Field P.); Pithecolobium; Prosopis (Mesquite, Screw Bean, Tornillo); Poinciana (Royal Poinciana, Peacock Flower, Flomboyant); Psoralea (Scurfy Pea, Pomme Blanche); Pueraria (Kudzu Vine); Robinia(Locust, False Acacia, Black Locust, Rose Acacia, Clammy Locust); Schrankia (Sensitive Brier); Sophora (Japan Pagoda Tree); Spartium (Spanish Broom); Sutherlandia (Bladder Senna); Swainsona (Winter Sweet Pea); Tamarindus (Tamarind); Templetonia (Coral Bush); Tephrosia (Goat's Rue, Catgut, Wild Sweet Pea, Hoary P.); Thermopsis; Trifolium (Clover, Alsike, Cowgrass); Trigonella (Fenugreek); Ulex (Gorse, Whin, Furze); Vicia (Vetch, Tare, Broad Bean, Windsor B., English Dwarf B.); Vigna (Cowpea, Black Pea, China Bean); Wistaria (Chinese Wistaria, Kidney-bean Tree).

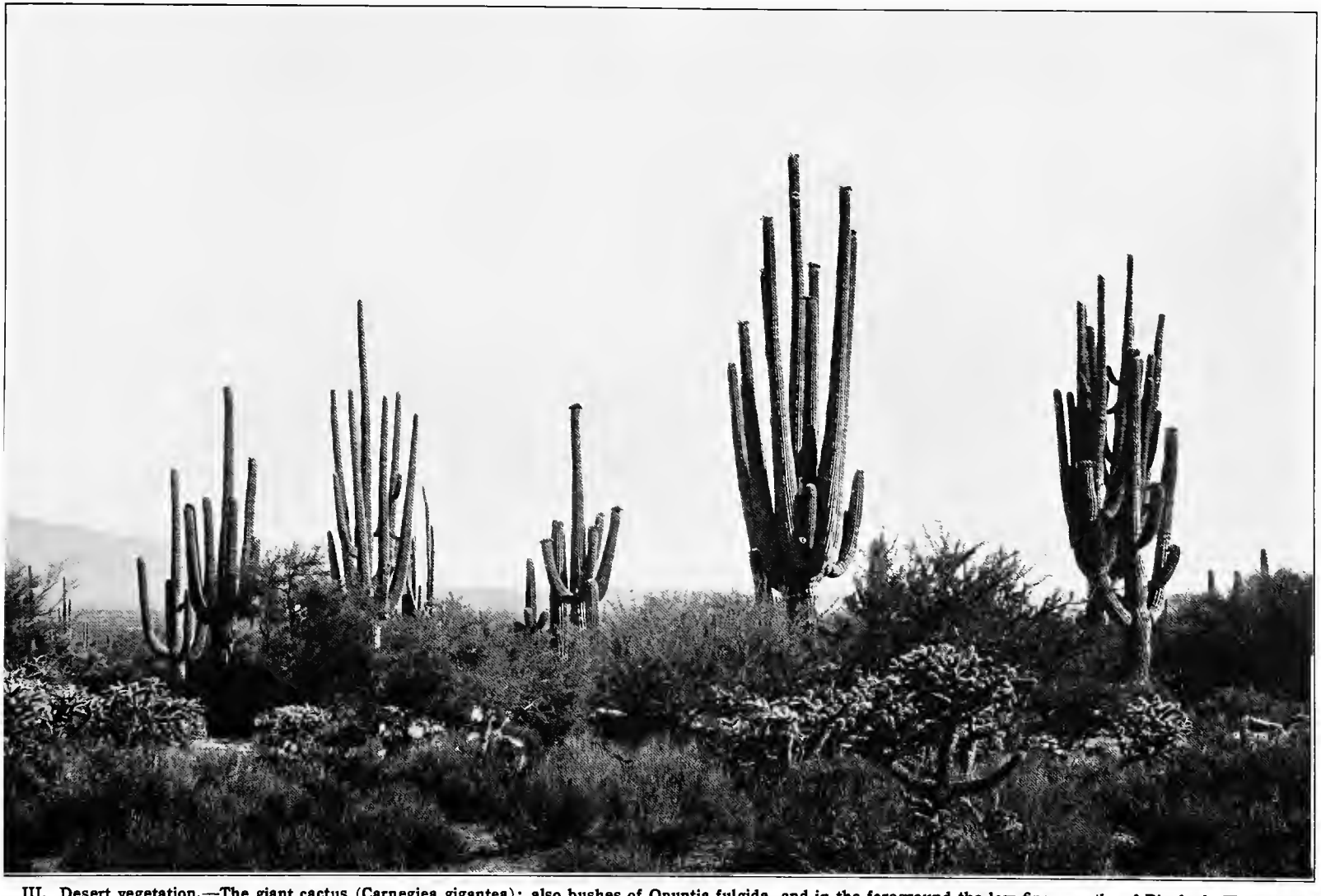
Order 38. Geraniales

104. **Geraniaceæ** (from the genus *Geranium*, Crane's-bill, from *geranos*, a crane, in allusion to the cranelike beak of the fruit). Geranium Family. Fig. 29. Herbs and shrubs, sometimes fleshy: leaves opposite or alternate, very diverse: flowers bisexual, regular or slightly irregular; sepals 5, imbricated, persistent; petals 5, rarely fewer, imbricated or convolute; stamens usually 10, rarely more, hypogynous or perigynous, the outer set opposite the petals, some frequently antherless, somewhat monadelphous below, often glandular at the base; carpels 5; ovary 5-celled, rarely 2–3-celled, 5-lobed, prolonged into a beak terminatd by the 5 styles; ovules 1 to many in each cell: fruit rarely a capsule, more commonly splitting into 5 beaked sections; seeds with endosperm, straight or curved.

The family has 10 genera and 360 species, widely distributed over the whole globe. The largest genera are Pelargonium (South Africa) with 175 species, and Geranium with 160 species. Some fossil fruits of Geraniaceæ are known. The Geraniaceæ are related to the Oxalidaceæ, Tropæolaceæ and Balsaminaceæ; also to the Linaceæ and Rutaceæ. The 5 sepals and petals, the 10 stamens, the 5 carpels, and the more or less beaked or lobed fruit with its peculiar dehiscence, are together distinctive.

The flower of Pelargonium is slightly irregular, with a dorsal receptacular spur at the base of the calyx. The fruits of all but 40 Geraniaceæ dehisce elastically, throwing the seeds to a distance. The 5 carpels split away at base, coil up violently, and remain attached to the summit of a column which projects from the receptacle. This method of dehiscence, when present, is characteristic of the Geraniaceæ.

The Geraniaceæ are astringent; several contain resin, and others contain free acids. Several species of



III. Desert vegetation.—The giant cactus (Carnegiea gigantea); also bushes of Opuntia fulgida, and in the foreground the low fine growths of Bigelovia Hartwegii.

Geranium have been used as remedies for wounds, others for dysentery, and the like; some have been used as stimulants. *Erodium moschatum* is valued because of a very strong odor of musk. The resinous stems of Monsonia (South Africa) burn readily, and have been used for torches. The most important economic genus is Pelargonium, cultivated for ornament. The foliage of some Pelargoniums is glandular and very fragrant ("rose geraniums"). Some species of Geranium also are ornamental. The awn-like beak of Erodium fruits have been used as hygrometers.

Few genera are in cultivation in America as ornamental plants: Erodium (Stork's-bill); Geranium, (Crane's-bill); Pelargonium (so-called "Geraniums"). Several cultivated genera, formerly included in the Geraniaceæ, are now placed in separate families, which see, e.g., Impatiens (Balsaminaceæ), Tropæolum (Tropæolaceæ), Oxalis and Averrhoa (Oxalidaceæ).

105. **Oxalidaceæ** (from the genus *Oxalis*, signifying *acid*, from the sour taste of the foliage). OXALIS FAMILY. Herbs, rarely shrubby: leaves usually compound: flowers bisexual, regular; sepals 5, persistent, imbricated; petals 5, convolute or imbricated, rarely united at the base; stamens 10 in 2 whorls, the outer set opposite the petals, filaments coherent below, those of the outer set shorter, one or both sets with external glandular appendages at the base, hypogynous; ovary superior, 5-celled, with a persistent central column (as in Geraniaceæ); styles separate: fruit an ordinary capsule with each cell dorsally dehiscent, or a berry.

The Oxalis family contains 7 genera and about 230 species, of which 220 belong to the genus Oxalis. They are mostly of tropical and subtropical distribution. Oxalis occurs chiefly in South Africa and South America. The Oxalidaceæ were formerly united with the Geraniaceæ, but differ in the fruit, which is a dehiscent capsule or a berry and does not break up into separate carpels.

The species of Oxalis are often bulbous or tuberous, or the roots are enlarged as water-storage tissue. The leaflets usually have a sensitive cushion at the base (pulvinus) and show sleep-movements. The flowers of many are dimorphic or trimorphic, i.e., have stamens or styles of 2 or 3 lengths in the same species. The seeds are forcibly ejected through the dorsal suture of the capsule by the elastic separation of the outer layer of the testa.

Oxalis contains much oxalic acid, which may be extracted for economic purposes. It is somewhat sedative, and the sour taste has made some species useful as salads. The starchy roots of some South American species are used for cattle-fodder. The fruits of Averrhoa are used in the tropics as a substitute for gooseberries, which they resemble in flavor.

Two genera are grown in America: Averrhoa (Carambola), 1 species grown for shade and fruit; and Oxalis.

106. **Tropæolaceæ** (from the genus *Tropæolum*, from *tropaion*, a trophy; the leaves are shield-like, and the flowers resemble a helmet). NASTURTIUM FAMILY. Fig. 29. Diffuse or climbing succulent herbs with alternate, peltate or lobed leaves: flowers bisexual, irregular, spurred; sepals 5, imbricated; petals 5, imbricated, the upper two differing in shape from the lower three; stamens 8, separate, somewhat perigynous; ovary superior, 3-celled, 3-lobed, each cell 1-seeded; style 1; stigmas 3: fruit splitting into 1-seeded, indehiscent nutlets or drupelets.

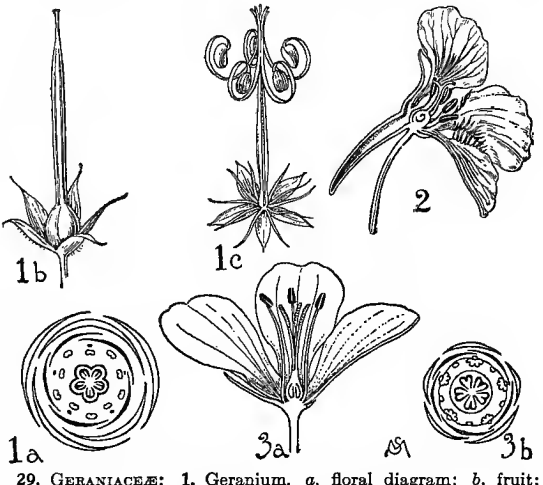
A single genus of about 35 species is found in the mountainous regions from Mexico to Chile. The family was formerly included in the Geraniaceæ, but is distinguished by its separate stamens, its indehiscent fruitlets, and a very peculiar method of embryo development, in which the suspensor divides into three parts, one part growing into the placenta, another out into the ovarian cavity, and the third producing the embryo on its apex. The spur of the flower is an outgrowth of the obliquely cup-shaped receptacle at the base of the calyx, as in Pelargonium.

The herbage of Tropæolum has an acrid taste like cress, and is often used for salad, hence the common name "nasturtium" or "Indian cress."

In America, several species are grown for their showy flowers. *Tropæolum majus* is the most widely known species. *T. peregrinum* is the "canary-bird flower."

107. **Linaceæ** (from the genus *Linum*, the Latin name for flax, from the old Celtic *llin*, a thread). FLAX FAMILY. Fig. 29. Woody or herbaceous plants: leaves alternate or opposite, rarely whorled, simple, entire: flowers bisexual, regular; calyx of 5, persistent, imbricated sepals, rarely 4-parted, with 3-fid lobes; petals 5, rarely 4, convolute, clawed, the claw sometimes crested; stamens 5, alternate with the petals, with sometimes 5 additional staminodia, or 10, 15, or 20, hypogynous, usually united at the often glandular base; ovary 5-, rarely 3- or 4-, celled or falsely 10-celled by the intrusion of the midrib; ovules few; styles as many as the cells of the ovary: fruit a capsule or drupe.

There are 9 genera and about 120 species, of which 90 species belong to Linum. The Linaceæ are related to



29. GERANIACEÆ: 1. Geranium, *a*, floral diagram; *b*, fruit; *c*, fruit dehiscing. TROPÆOLACEÆ: 2. Tropæolum, flower. LINACEÆ: 3. Linum, *a*, flower; *b*, floral diagram.

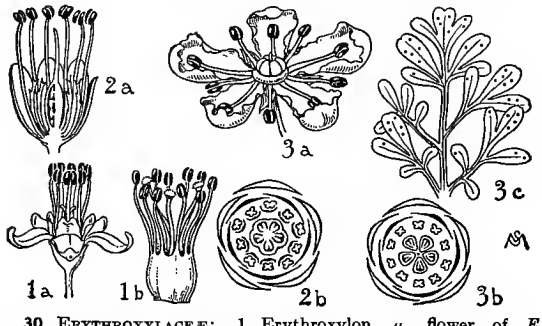
the Geraniaceæ and Oxalidaceæ, but also show a relation to the Silenes in the Caryophyllaceæ. The many-stamened genera suggest the Ternstrœmiaceæ. The family is most easily recognized by the simple, regular pattern of the flower, and the numerical plan of 5 (or 4) which is carried through all the floral parts. For this reason, the flax was taken by the older botanists as a pattern flower.

Linum catharticum (Europe) was formerly used as a purgative. A fixed oil is extracted from the seeds of the common flax (*Linum usitatissimum*), which is used in medicine as an emollient. The most extensive use of this oil is in painting, its value being due to the property of drying into a hard, waterproof coating. Flaxseed meal, from which the oil has been expressed, is used for fodder and for poulticing. The seed-coats of flax become very mucilaginous when soaked, on which account flaxseed has also been used as an emollient in the treatment of coughs and colds. The cortical bast-fibers of the flax have been used since earliest times in textile industries. As the basis of linen cloth, flax is one of the most useful of cultivated plants. Flax was probably Asiatic in its origin. Many species of Linum are ornamental, but are little grown.

Two genera are cultivated in America: Linum, with species of annual garden plants; and Reinwardtia, with species of conservatory sub-shrubs from India.

108. **Erythroxylaceæ** (from the genus *Erythroxylon*, the name signifying *red wood;* the wood of some species being red). Coca Family. Fig. 30. Shrubs and small trees: leaves alternate: flowers bisexual, regular, inconspicuous; sepals 5, persistent, imbricated or valvate; petals 5, convolute or imbricated, with appendages on the inner face, or with projecting callosities; stamens 10, in 2 whorls, more or less connate into a tube, and externally glandular; ovary 3–4-celled, usually but 1 cell developing in fruit; 1–2 ovules in each cell; styles 3–4: fruit drupaceous, 1–2-seeded.

Two genera and about 90 species are known; all tropical, and reaching their greatest development in



30. Erythroxylaceæ: 1. Erythroxylon, *a*, flower of *E. pulchrum; b*, flower, perianth removed, of *E. Coca*. Zygophyllaceæ: 2. Zygophyllum, *a*, flower; *b*, floral diagram. Rutaceæ: 3. Ruta, *a*, flower; *b*, floral diagram; *c*, leaf.

tropical South America, but extending northward to Mexico and southward in the Old World to Natal. The family is closely related to the Linaceæ with which it was formerly united, but differs in the more prominent stamen-tube, the appendages on the petals, and the drupaceous non-capsular fruit.

The only important economic plant is the coca plant (*Erythroxylon Coca*), a shrub famous as the source of cocaine. Its origin is unknown, but it was early used by the Peruvians as a stimulant. Coca is now grown to a limited extent in southern Florida and southern California, as well as in most tropical countries.

109. **Zygophyllaceæ** (from the genus *Zygophyllum*, derived from the Greek signifying a *yoke* and *leaf;* the leaflets are in pairs). Caltrop Family. Fig. 30. Herbs, shrubs, or trees: leaves opposite, rarely alternate, mostly pinnately compound: flowers bisexual, regular, rarely irregular; sepals 4–5, persistent, imbricated or rarely valvate; petals 4–5, rarely 0, imbricated, rarely valvate; disk present, diverse, rarely wanting; stamens usually 8 or 10, hypogynous, the outer opposite the petals, usually scales at the base of the filaments; ovary superior, 4–5-celled, rarely falsely many-celled; ovules 2 to several in each cell; style and stigma 1: fruit a capsule or separating into fruitlets.

Twenty-one genera and about 150 species occur as natives of the warmer parts of the world, especially the drier desert regions. They are especially abundant in North Africa and the Mediterranean region. This family is very closely related to the Rutaceæ, from which it differs in the absence of glandular dots and oil, and in the presence of stipules. The fruits are usually more or less lobed and sometimes winged or covered with prickles.

The hard, faintly aromatic wood (lignumvitæ) of *Guaiacum officinale* is used for cabinet work and for pulleys. The wood of this plant yields a resin used as a diaphoretic and purge. The flower-buds of one species of Zygophyllum are used in place of capers.

The Arabs use *Z. simplex* to remove freckles. The fetid smell of this plant is so strong that even camels are said to reject it. Soda is obtained from species of Nitraria, which inhabit alkaline soil.

Guaiacum officinale is sometimes grown in southern Florida and southern California for ornament. Zygophyllum may be in cultivation.

110. **Rutaceæ** (from the genus *Ruta*, the ancient name). Rue Family. Fig. 30. Herbs, shrubs, trees: leaves usually alternate, simple or variously cut or compound, usually with pellucid dots: flowers bisexual, usually regular; sepals 4–5, often coherent, imbricated; petals 4–5, imbricated or valvate, usually separate; stamens 8–10, rarely 15, inserted at the base of a thick disk, usually distinct; ovary superior, 2–5-lobed, 2–5-celled; each cell 1 to many-ovuled, raised on a prolongation of the receptacle, a glandular disk at its base; styles usually connate: fruit a capsule opening by valves, or fleshy and indehiscent, or separating into fruitlets, rarely winged.

Rutaceæ contains over 100 genera and about 900 species, mostly of tropical countries but extending into temperate parts of Europe and America. Fagara, with more than 130 species, is the largest genus. The Rutaceæ are related to many of the Geranium group, especially to Simarubaceæ, Zygophyllaceæ, and Meliaceæ. The transparent dots in the leaves, the numerical plan, and especially the lobed ovary raised on the disk or stalk, are together distinctive. The disk is often much developed and very diversely constructed. The outer stamens are usually opposite the petals, not alternate with them as might be expected. In some cases the carpels are entirely free below and united only by the styles or stigmas. The seeds, except in the berry fruits, are only 1 or 2. The great development of oil-glands containing a fragrant oil is one of the most characteristic features of the family. These glands are produced on all parts of the plant, even on the floral parts and surface of the fruits. The orange and lemon are examples of Rutaceæ with berry fruits, and they are widely cultivated and perplexingly variable.

The volatile oil of the Rutaceæ has been used to some extent for medicine and also for perfumery. Extract of rue has been used as a vermifuge. The Romans used rue as a condiment. Some species of rue are so pungent as to produce a poisoning of the skin similar to that produced by poison ivy. The volatile oil is so copious in Dictamnus as to ignite readily. Several species of Barosma (buchu) are tonic and diuretic. The genus Citrus is the most useful. It includes the orange, the bitter orange, the citron, the lemon, the lime, the grape-fruit, the kid-glove orange or tangerine, and the bergamot from the rind of which bergamot oil is manufactured, used in perfumery. The bark of the prickly shrub, Zanthoxylum, is sometimes used as a tonic. The seeds of some species of Zanthoxylum are used to poison fish.

In cultivation in America or worthy of trial are 20 to 30 genera, used mostly for ornament and fruit. Among these are: Adenandra (Breath of Heaven); Ægle (Bael Fruit, Bengal Quince); Atalantia; Balsamocitrus (African Bael-Fruit); Calodendron (Cape Chestnut); Casimiroa (White Sapota); Citrus (Orange, Lemon); Dictamnus (Dittany, Gas Plant, Burning Bush); Fagara (Prickly Ash); Feronia (Wood Apple); Murraya (Orange Jessamine, Satinwood); Phellodendron (Chinese Cork Tree); Poncirus (Trifoliate Orange); Ptelea (Hop Tree); Ruta (Rue); Triphasia (Bergamot Lime, Lime Berry); Zanthoxylum (Prickly Ash, Chinese or Japanese Pepperwood, Toothache Tree).

111. **Simarubaceæ** (from the genus *Simaruba*, which is the Caribbean name of *Simaruba officinalis*). Quassia Family. Fig. 31. Shrubs or trees: leaves alternate or rarely opposite, pinnate, rarely simple, dotless: flowers unisexual, regular; sepals 3–5, more or less connate, imbricated or valvate; petals 3–5, rarely 0, free or connate, variously arranged in the bud; disk prominent, very diverse, rarely 0; stamens usually twice the petals, filaments naked or with a scale; carpels 2–5, free, or

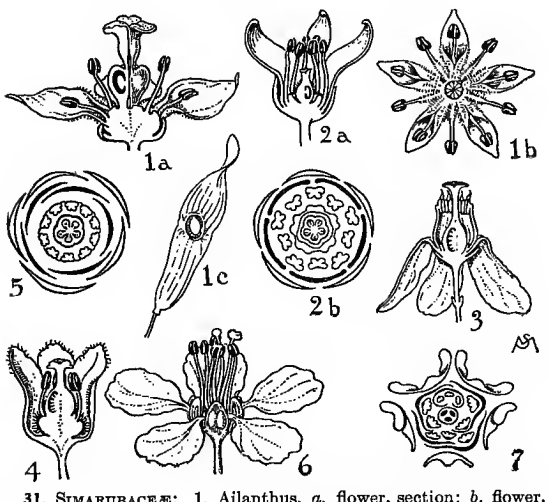
connate at the base or by the styles, or completely united into a 2–5-celled, superior ovary; each cell 1-, rarely several-, ovuled; carpels in fruit drupe-like, rarely forming a berry or samaras.

About 28 genera and 140 species are generally distributed in the tropics, but extend into the temperate regions. The center of distribution is in tropical America. Some fossil species are known. The family is closely related to the Rutaceæ, but differs in the absence of foliage-glands and in the presence of scales on the filaments. It is also closely related to the Zygophyllaceæ.

Most of the Simarubaceæ contain a bitter principle, also, sometimes, a resinous matter and an oil which is of value as a tonic. *Quassia amara* of tropical America furnishes the quassia wood, famous as a bitter tonic. *Picrasma excelsa*, of Jamaica, also furnishes quassia of equal quality. Branches of quassia and the pulverized bitter wood of species of Simaruba are used in tropical America to drive away insects. The seeds of *Simaruba Cedron* are used for the same purpose. Various species are used for snake-bites. The leaves and sap of species of Picramnia furnish a beautiful violet dye.

Very few are in cultivation in America: Picrasma, a semi-hardy shrub; and Ailanthus (Tree of Heaven), a well-known tree.

112. **Burseraceæ** (from the genus *Bursera*, named in memory of Joachim Burser, a botanist in Naples). BURSERA FAMILY. Fig. 31. Trees or shrubs, often very large, with usually alternate compound leaves: flowers bisexual, regular, usually small and very numerous; sepals 3–5, more or less connate, imbricated or often valvate; petals 3–5, usually separate, imbricated or valvate; stamens usually twice as many as the petals, hypogynous, sometimes unequal, separate, the outer opposite the petals; disk present, annular or cup-shaped, rarely 0, sometimes adnate to the calyx; ovary superior, 2–5-celled; ovules usually 2 in each cell; style 1 or 0: fruit drupe-like with 2–5 stones or with a bony endocarp or a capsule with the epicarp opening and exposing the connate bony pits; seeds exalbuminous.



31. SIMARUBACEÆ: 1. Ailanthus, *a*, flower, section: *b*, flower, looking in; *c*, fruit. BURSERACEÆ: 2. Bursera, *a*, flower; *b*, floral diagram. MELIACEÆ: 3. Swietenia, flower. 4. Cedrela, flower. 5. Melia, floral diagram. MALPIGHIACEÆ: 6. Camarea, flower. 7. Malpighia, floral diagram.

The 16 genera and about 270 species are widely distributed in tropical regions. One species of Bursera reaches Florida. The family is related to the Rutaceæ and Simarubaceæ, from which it differs in the presence of resin-chambers in the bark. It is also very closely related to the Anacardiaceæ.

The family is very rich in resin and, therefore, is of considerable economic importance. These resins are frequently aromatic or fragrant; hence many have been used as incense. The resin myrrh is obtained from species of Commiphora of Arabia and Africa. Mecca balsam is from the same genus. Olibanum incense is derived from trees of the genus Boswellia, of India. Frankincense is either this olibanum or the resin from *Boswellia Carteri*. A substitute for dammar and copal has been obtained from the Burseraceæ.

Few species of the Burseraceæ are in cultivation in America: *Bursera Simaruba*, as an ornamental greenhouse tree; and *Garuga pinnata*, which is grown in Florida and California for the gooseberry-like fruit.

113. **Meliaceæ** (from the genus *Melia*, the Greek name of the somewhat similar manna-ash). MAHOGANY FAMILY. Fig. 31. Trees or shrubs: leaves usually alternate, pinnate or rarely simple: flowers bisexual, rarely unisexual, panicled; sepals 4–5, usually partly connate, imbricated; petals 4–5, rarely 3–8, separate, or connate or adnate to the stamens; stamens 8–10, rarely 5, or numerous, hypogynous, filaments usually connate into a tube which is entire or lacerate, rarely free; disk present; ovary superior, 2–5-celled, rarely 1- or many-celled, each cell 2-, rarely several-, ovuled; style and stigma 1: fruit a drupe, berry, or capsule.

There are 42 genera and about 600 species, all confined to the tropics. They enter the United States only in southern Florida. Some fossil species are known. The family is related to the Rutaceæ, but lacks the resin and oil-glands. It is closely related to all of the disk-bearing families, but is distinguished by the peculiar stamen-tube with teeth and fringe.

There is the greatest diversity in the arrangement of the anthers on the staminal tube and the dentation or fringing of the latter. Very commonly there are 2 stipule-like teeth just below the anthers. The seeds are sometimes winged (in mahogany). The leaves are rarely transparent-dotted (Flindersia).

Melia Azedarach, an Asiatic tree, is bitter, and has been used in medicine as a purgative and vermifuge. Other species of Meliaceæ are purgative and emetic, or are used for heartburn, and the like. Some have the odor of garlic. The bark of the Asiatic *Walsura piscidia* is used to stupefy fish. The pulp of the fruit of *Aglaia edulis* is said to be delicious. The bitter bark of mahogany has been used in place of quinine. The most celebrated member of the family is *Swietenia Mahogani* of the West Indies and Peru, which furnishes the mahogany timber of commerce. The wood of the West Indian *Cedrela odorata* is fragrant, and is the so-called cigar-box cedar, from which these boxes are made. The sawdust of the South African sneezewood (*Ptæroxylon obliquum*) causes sneezing, hence the popular name.

Five or more genera are in cultivation in America, all confined to southern California and southern Florida, except Melia, which is common throughout the southern states, and *Cedrela sinensis*, hardy in Mass. Among these are Cedrela (West Indian Cedar); Melia (Pride of India, China-berry Tree, Texas Umbrella Tree); Ptæroxylon (Sneezewood); Swietenia (Mahogany).

114. **Malpighiaceæ** (from the genus *Malpighia*, in honor of Marcello Malpighi, once professor of medicine at Pisa). MALPIGHIA FAMILY. Fig. 31. Trees or shrubs, most often climbing: leaves usually opposite, often with petiolar glands and jointed petioles: flowers commonly bisexual, usually obliquely irregular; sepals 5, mostly separate, some or all with large glands; petals 5, fringed or toothed, slender-clawed; stamens 10, in part staminodial, rarely fewer, the outer opposite the petals, hypogynous or nearly so, usually connate below; anthers very diverse and odd; ovary superior, 2–3-celled and lobed, rarely 5-celled, the cells 1-ovuled; styles 2–3, rarely connate: fruit commonly separating into 2–3 nut-like portions which are entire, or pectinately winged, or naked, rarely a single nut or drupe; seeds

exalbuminous; embryo variously curved or spiral, rarely straight.

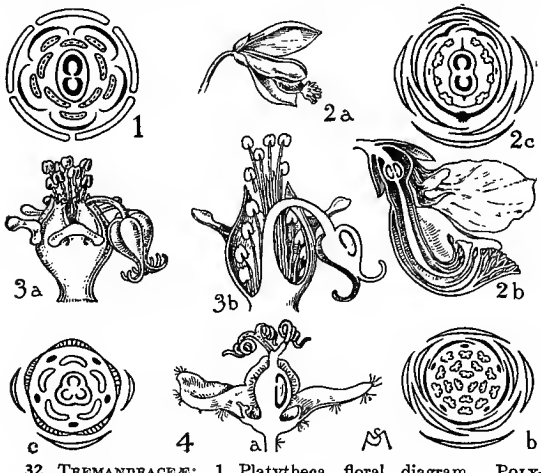
This family has 55 genera and about 650 species, generally distributed in the tropics, but reaching to Texas and California in North America, and Port Natal in Africa. They are most abundant in the tropical forests of South America. The family is closely related to the Zygophyllaceæ, Sapindaceæ, and Erythroxylaceæ, as shown by the lobed and winged fruit, or clawed petals. The glandular calyx, clawed petals, the outer stamens opposite the petals, peculiar anthers, queer fruit, and curved embryo are together distinctive.

The family is of little economic importance. Various coloring matters and astringent tannins are contained in the bark, for which reason some of the Malpighiaceæ have been used for dysentery and intermittent fever. Some are used as a remedy for snake-bites. The fruits of certain Malpighiaceæ are sour, juicy and refreshing.

Few species are in cultivation in North America, all in California, Florida or the West Indies. Galphimia and Stigmaphyllon are ornamental; *Malpighia glabra* is the Barbadoes cherry, cultivated in the West Indies for the cherry-like fruit.

115. **Tremandraceæ** (from the genus *Tremandra*, which is from the Latin *tremble* and the Greek *male*, probably in allusion to the anthers). TREMANDRA FAMILY. Fig. 32. Shrubs or sub-shrubs, with opposite, whorled or alternate leaves: flowers bisexual, regular; sepals 4–5, rarely 3, valvate; petals of the same number as the sepals and alternating with them, colored, entire, separate induplicate-valvate; stamens 8 or 10, rarely 6, hypogynous, in 1 or 2 whorls; anthers opening by a transverse terminal valve, or more or less prolonged into a beak with terminal pores; ovary superior, 2-celled; style 1; stigma 1: fruit a capsule; seeds 1 or 2 in each cavity.

In this family are 3 genera and about 23 species, of which 20 belong to the genus Tetratheca. All are native of south and west Australia. The family is very similar to the Polygalaceæ, and separated from that



32. TREMANDRACEÆ: 1. Platytheca, floral diagram. POLYGALACEÆ: 2. Polygala, *a*, flower; *b*, flower, vertical section; *c*, floral diagram. EUPHORBIACEÆ: 3. Euphorbia, *a*, involucre and flowers; *b*, involucre, vertical section. 4. Croton, *a*, flower; *b*, floral diagram, male flower; *c*, floral diagram, female flower.

family only by the regular flowers. Platytheca is remarkable in having the four anther cells all in one plane.

Two genera are in the American trade, both tender heath-like plants: Platytheca, and Tetratheca.

116. **Polygalaceæ** (from the genus *Polygala*, an old Greek name applied later to this genus by botanists because of the supposed stimulative action of the plant on the lactation of cattle). MILKWORT FAMILY. Fig. 32. Herbs, shrubs, or small trees, sometimes climbing or twining: leaves mostly alternate: flowers bisexual, irregular; sepals 5, imbricated, separate or somewhat coherent, the 2 inner largest and often winged or petaloid; petals rarely 5, commonly 3, at least the 2 upper, and sometimes all more or less coherent with each other and with the stamen-tube, inner petal concave and often with a fringed crest (keel); stamens 8, rarely fewer, in 2 whorls, hypogynous, usually adherent to the keel petal and coherent into a tube which is slit down and open behind; anthers usually opening by terminal pores or slits; ovary superior usually 2-celled; ovule usually 1 in each cell; style 1, dilated above; stigmas 1–4: fruit usually a capsule, rarely a drupe or samara; seeds pendulous, albuminous.

Polygalaceæ has 10 genera and about 500 species, 450 of which belong to the genus Polygala; widely distributed over the earth but absent in New Zealand, Polynesia, arctic North America and arctic Asia. The family is not closely related to any other. The peculiar perianth and stamens, and the 2-celled ovary, are together very distinctive. The floral parts, though simulating those of the Leguminosæ, are not homologous.

A bitter principle gives the Polygalaceæ tonic and astringent properties. Some species are emetic. The root of *Polygala Senega* (North America), so-called "Senega or Seneca snakeroot," is used as an emetic and cathartic, but more especially as an expectorant. This and many other species of Polygala are reputed antidotes for snake-bites, hence the name "snakeroot."

Only the genus Polygala is in cultivation in N. America, of which 9 or 10 species are grown for ornamental purposes. Some are shrubs and 1 is an evergreen trailer.

117. **Euphorbiaceæ** (from the genus *Euphorbia*, named in honor of Euphorbus, physician to King Juba). SPURGE FAMILY. Fig. 32. Herbs, shrubs or trees, of greatly varying habit, sometimes fleshy and cactus-like, often with milky juice: leaves mostly alternate: flowers monœcious or diœcious, regular or irregular; both calyx and corolla present, or the latter absent, or both absent, or both much reduced, valvate or imbricated; the parts free, rarely united; intrastaminal disk usually present in the staminate flowers, often changed to glands; stamens as many as the sepals, or twice as many, or reduced to 1, separate or monadelphous; hypogynous disk in the pistillate flowers annular or cup-shaped or in the form of glands; ovary superior, usually 3-celled, rarely 1-, 2-, or 4-celled; style and stigma various; ovules 1–2 in each cavity, side by side, suspended, anatropous; micropyle external, covered with a caruncle: fruit splitting into three portions, leaving a central column, rarely indehiscent and berry-like, or drupaceous; seeds albuminous.

The 208 genera and about 4,000 species are widely distributed, mainly in the tropics, but extend into temperate regions. The largest genera are Euphorbia with about 700 species, Croton with 500–600 species, and Phyllanthus with 400 species. The family is related to the Geraniales, as shown by the fruit. The only constant characters of this great polymorphic family are the collateral anatropous ovules with micropyle external, the caruncle, the usually persistent axis of the fruit, and the albuminous seeds. In Euphorbia, some sessile staminate flowers and a pedicelled pistillate flower are inclosed in a common involucre which bears various horn-like, or gland-like, or petaloid appendages. The variation in the inflorescence and floral structure throughout the family is very intricate.

The family is of great economic importance. Only the most important plants can be mentioned here. The following are used in medicine: The juice of *Euphorbia Esula*, *E. Cyparissias*, *E. Lathyris*, *E. helioscopia*, and others, is purgative, as is also that of Mercurialis. *Croton Tiglium* yields the purgative croton oil. *Ricinus communis* yields castor oil. *Jatropha Curcas* (physic nut) is purgative. *Euphorbia Hyberna*, *Jatropha*

officinalis, Croton, and *Stillingia sylvatica* (queen's root) are used for syphilis. *Euphorbia corollata* and *E. Ipecacuanhæ* are emetic. *E. thymifolia* is used as a vermifuge in India. *Croton Eluteria* yields cascarilla bark, a tonic. The hairs of the capsule of *Mallotus philippinensis* are in the trade as kamala. The juice of *E. cotinifolia* is used by the Caribbeans to poison arrows; that of *Excæcaria Agallocha* (blinding tree) is so acrid as to blind the eye into which it may chance to fall. The juice of *E. balsamifera*, of the Canaries, is cooked and eaten as jelly. The seeds of *Aleurites triloba* are called "almonds," and eaten; as are also those of *Conceveiba guyanensis*. The fruit of *E. disticha* is edible. *E. Emblica* has fleshy, sweet fruit. The most useful as food are the tuberous roots of the sweet manioc (*Manihot palmata* var. *Aipii*), eaten cooked or raw; and of the bitter manioc (*M. utilissima*), which is poisonous when raw, but when cooked is very widely used for food in the tropics. This root is the source of cassava bread, and tapioca. Phosphorescent juice is obtained from *E. phosphorea* of Brazil. The fruit of *Hura crepitans* (sand-box) opens with a report like a pistol. It is cooked in oil to prevent dehiscence, and used as a sand-box. India rubber is obtained from the juice of *Hevea guyanensis*, and other species. *Omphalea triandra* yields a blackening juice used as ink. Soap is made from the seminal oil of *Jatropha Curcas*. Oil from the seeds of *Aleurites cordata* (Japanese oil tree) is used for lighting. Turnsole (*Crozophora tinctoria*), of the Mediterranean, yields a dye used to color Dutch cheese. Other Euphorbiaceæ yield dyes. *Sapium sebiferum* (Chinese tallow tree) yields a fat used for burning, and other purposes.

Twenty to 30 genera are in cultivation in N. America for various purposes. Among these are: Acalypha, ornamental; Aleurites (Candlenut, Candleberry Tree), California; Codiæum (Croton), ornamental; Euphorbia (Spurge, Snow-on-the-Mountain, Scarlet Plume, Poinsettia, Mexican Fire Plant, Hypocrite Plant, Painted Leaf, Fire-on-the-Mountain, Crown of Thorns, Medusa's Head, Caper Spurge, Mole Plant), greenhouse, garden, ornamental; Hevea (South American Rubber Tree), botanical gardens and Florida; Jatropha (French Physic Nut), South; Manihot (Ceara Rubber Tree, Cassava, Manioc Plant), South, food and ornamental; Pedilanthus (Bird Cactus, Jew Bush), greenhouse; Phyllanthus (Snow-bush, Emblic Myrobolan, Otaheite Gooseberry), greenhouse, garden; Putranjiva (Indian Amulet Plant), South; Ricinus (Castor-Oil Plant, Palma Christi), garden, ornamental; Stillingia (Queen's Root, Queen's Delight); Sapium (Tallow Tree), South.

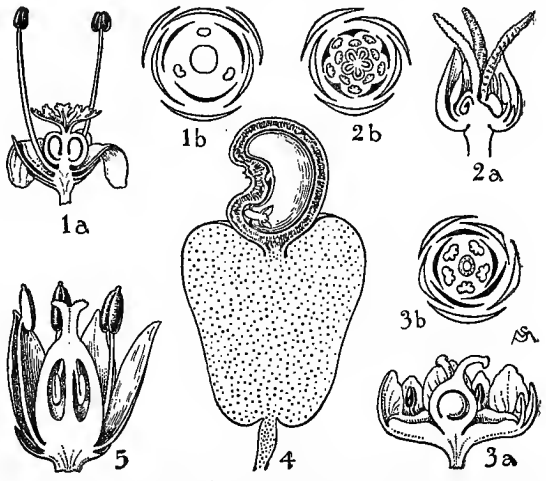
Order 39. Sapindales

118. **Buxaceæ** (from the genus *Buxus*, the ancient name of the box). Buxus Family. Herbs, shrubs or trees: leaves opposite or alternate: flowers monœcious, inconspicuous; hypogynous disk wanting; corolla absent; calyx 4-parted, or in the pistillate flower 4–12-parted or 0, imbricated; stamens 4, opposite the lobes of the calyx, or numerous; ovary superior, 3-celled, rarely 2–4-celled; ovules 2, collateral, rarely 1, suspended, micropyle turned toward the axis; styles 2–3: fruit capsular and opening elastically, or fleshy; seeds with endosperm, with or without a caruncle.

About 6 genera and 30 species inhabit the tropics and subtropics. One species is native in the southeastern United States. The largest genus is Buxus with 19 species. Fossil species are known. The family is related to the Euphorbiaceæ, with which it is united by some authors, and to the Celastraceæ and Empetraceæ. The absence of milky juice, the calycoid perianth, the 3-celled ovary with collateral suspended albuminous seeds, and the axially directed micropyle are together characteristic.

The wood of the box (*Buxus sempervirens*) of Europe is close-grained and homogeneous; used for engraving and for the manufacture of musical instruments. A decoction of the wood was formerly used in medicine for fevers. Its leaves and seeds are purgative. Oil from the seeds of Simmondsia is used as a hair-tonic.

Four or more genera are in cultivation in America. These are: Buxus (Box) ornamental; Pachysandra



33. Empetraceæ: 1. Empetrum, *a*, flower; *b*, floral diagram. Coriariaceæ: 2. Coriaria, *a*, flower; *b*, floral diagram. Anacardiaceæ: 3. Rhus, *a*, flower; *b*, floral diagram. 4. Anacardium, fruit. Cyrillaceæ: 5. Cyrilla, flower.

(Mountain Spurge), garden, ornamental; Sarcococca, greenhouse, ornamental; and Simmondsia, California, for oil.

119. **Empetraceæ** (from the genus *Empetrum*, an ancient name signifying *upon a rock*). Crowberry Family. Fig. 33. Small ericoid shrubs: leaves alternate, deeply furrowed beneath: flowers polygamous or dicœcious, small, regular, hypogynous; disk wanting; sepals 2–3, imbricated; petals 2–3, or 0; stamens of the same number as the petals and alternate with them; ovary superior, 2–9-celled, each cell 1-ovuled; style-branches 2–9, often fringed or toothed: fruit drupaceous; seed ascending, anatropous, albuminous; micropyle turned toward the outside.

In the north temperate and arctic regions, and in the Andes, are found 3 genera and about 5 species. The family is related to the Buxaceæ, and more distantly to the Euphorbiaceæ and Celastraceæ. The habit, the reduced or absent corolla, the few stamens, the 1-seeded ovary, the external micropyle, and the absence of the disk and aril are together distinctive.

The acid berries of Empetrum are eaten in north Europe and Kamtschatka, and also used to prepare a drink. The fruit of *Corema album* has been used as a fever remedy. An acid drink is prepared from it in Portugal.

In North America, 2 genera are in cultivation: Ceratiola, not hardy; and Empetrum (Crowberry), grown in rock-gardens.

120. **Coriariaceæ** (from the genus *Coriaria*, derived from the Latin meaning *a hide*, used for tanning). Coriaria Family. Fig. 33. Shrubs with opposite or whorled, entire leaves: flowers bisexual, or unisexual, regular; sepals 5, imbricated; petals 5, smaller, but enlarging in fruit, fleshy, keeled within and pressed between the carpels; stamens 10, hypogynous; carpels 5–10, superior, separate: fruitlets indehiscent, 1-seeded, dry.

This family consists of a single genus containing 8 species, widely distributed in warm-temperate zones. Coriariaceæ is not closely related to any other family;

perhaps most closely to the Empetraceæ. Some authors place it near the Sapindaceæ or Phytolaccaceæ, or Rutaceæ. It represents an ancient group. Fossil species are known.

Coriaria myrtifolia (myrtle-leaved sumach) of the West Mediterranean region, contains much tannin and is used by curriers; its leaves and fruits are poisonous. The fruit of *C. ruscifolia* of New Zealand contains a vinous juice, which is drunk as a beverage, but its seeds are poisonous. *C. ruscifolia* also yields a black color used by shoemakers.

Two species are grown for ornamental purposes in eastern North America. They are semi-hardy.

121. **Limnanthaceæ** (from the genus *Limnanthus*, the name signifying marsh flower). LIMNANTHUS FAMILY. Herbs with alternate leaves: flowers bisexual, regular; sepals 3 or 5, valvate; petals 3 or 5, convolute, separate; stamens twice as many as the petals, the outer opposite the petals, often glandular at base; ovary superior, 3- or 5-lobed, 3- or 5-celled; ovules 1 in each cell, ascending, micropyle directed downward and outward; stigmas 3 or 5: fruit dry, separating into segments.

This is a small family of 2 genera and 5 species, all of North America. The family was formerly united with the Geraniaceæ, to which the floral structure bears a superficial resemblance. It is also related to the Anacardiaceæ and Sapindaceæ. It may be said to possess the general floral structure and lobed ovary of the Geraniaceæ, but the seed position of the two families last named.

Limnanthus Douglasii, of California, is grown for ornamental purposes.

122. **Anacardiaceæ** (from the genus *Anacardium*, the name meaning *heart-like*, in reference to the shape of the nut). CASHEW FAMILY. Fig. 33. Trees or shrubs with resinous bark, and alternate, simple or compound leaves: flowers bisexual or unisexual, regular, small, and numerous, epigynous, perigynous or hypogynous; sepals 3–5; petals 3–5, mostly imbricated, or 0; stamens 5 or 10, rarely many, inserted with the petals at the edge or base of an annular, intra-staminal disk; ovary 1-, rarely 2–6-, celled, with 1 ovule in each cell; styles 1–6: fruit a drupe or nut, rarely dehiscent; seeds usually exalbuminous.

There are 58 genera and about 400 species, most abundant in the tropical zone of both hemispheres, but represented by the genus Rhus as far north as Europe and the United States. Rhus is the largest genus, containing 120 species. The family is related to the Sapindaceæ, but contains resin, and has an intra-staminal disk. It is also related to the Burseraceæ and Simarubaceæ.

The disk in some genera becomes elongated into a stalk on which the ovary is raised. The drupe is sometimes edible (Mangifera). In Anacardium, the nut-like fruit is situated on top of a fleshy edible receptacle. Sometimes the nut is surrounded by the edible receptacle. In Cotinus, the pedicles become plumose and the whole much-branched inflorescence breaks off, and blows about, distributing the seeds. In Swintonia, the calyx or the corolla becomes enlarged and persistent and serves as a parachute in seed-dissemination. *Rhus Toxicodendron* (poison ivy) and *R. Vernix* (poison sumach, poison elder, poison dogwood) contain in all their parts an oily, extremely irritating substance, which often produces a very painful vesicular eruption that may last for several days.

The Anacardiaceæ is a family of considerable economic importance. Because of the resinous juice, it yields medicinal substances and varnishes. It also yields important edible fruits. *Pistacia vera* of Syria furnishes the pistachio nut; *Pistacia Terebinthus* of the Mediterranean yields Cyprus turpentine, formerly medicinal. The leaves of *Rhus Coriaria* of the Mediterranean are used for tanning fine leather. *Rhus succedanea* of Japan yields vegetable wax, which coats the seed within the capsule. *Melanorrhœa usitata* yields a celebrated black varnish of Burmah. *Mangifera indica* of the East Indies is the mango tree, the fruit of which is large, juicy, sugary-acid and agreeable. *Anacardium occidentale* of tropical America is the cashew. This plant yields edible nuts and an edible receptacle. From it vinegar is made, also a peppery oil used as a condiment; and the trunk yields a valuable acacia-like gum. The seeds of Semecarpus (marking-nut tree) give an indelible black dye used in marking linen. *Spondias purpurea* is the so-called Spanish plum of the West Indies. The fruit of *Spondias dulcis* of the Pacific Islands is also frequently eaten. Other species furnish the hog plum of the West Indies. The mastic, a fragrant gum-resin of the pharmacist, is obtained from *Pistacia Lentiscus* of the Orient.

Eight to 12 genera are in cultivation in N. America, but with the exception of Rhus and Cotinus, mostly in the southern states, especially in southern Florida and southern California. Among these are: Anacardium (Cashew Tree); Cotinus (Smoke-bush); Cyrtocarpa, fruit edible; Mangifera (Mango); Pistacia (Pistachio Nut); Rhus (Sumach, Poison Ivy, Poison Oak, Poison Elder, Poison Dogwood), 15 species; Schinus (California Pepper Tree, Peruvian Mastic); Semecarpus (Marking-nut Tree).

123. **Cyrillaceæ** (from the genus *Cyrilla*, named in honor of Dominico Cyrillo, a professor of medicine at Naples). CYRILLA FAMILY. Fig. 33. Shrubs with alternate, entire leaves: flowers bisexual, regular, small; sepals 5, often enlarged in fruit, imbricated; petals 5, imbricated, slightly connate at base or separate; stamens 5 or 10, hypogynous, the inner sometimes wanting, filaments dilated; ovary superior, 2–4-celled; ovules 1, rarely, 2–4 in each cell; style short; stigmas 2: fruit a fleshy or dry capsule, or nearly dry drupe with wings; seeds albuminous.

The 3 genera and only 5 species are all American, ranging from Virginia to Brazil. The relationship of the Cyrillaceæ is doubtfully understood. It is probably closely related to the Aquifoliaceæ, although some have placed it with the Ericaceæ. The small polypetalous flowers, the few stamens, the several-celled, few-seeded ovary, the dry fruit and the non-arillate seeds are important characteristics.

Cyrilla racemiflora (leatherwood, black ti-ti) of the southeastern United States is occasionally cultivated for ornamental purposes.

124. **Aquifoliaceæ** (from *Aquifolium*, Tournefort's name for the genus Ilex, application obscure). HOLLY FAMILY. Fig. 34. Trees or shrubs, with alternate or opposite, simple, often evergreen leaves: flowers bisexual, rarely unisexual, very small, axillary, solitary or fascicled, rarely cymose; sepals 3–6, more or less connate; petals 4–5, nearly separate, imbricated; stamens 4–5, alternating with the petals, and sometimes adhering to them, hypogynous disk wanting; ovary superior, 3 to many-celled, each cell 1–2-ovuled; stigma subsessile, lobed: fruit berry-like; seeds albuminous.

Three genera are known and about 280 species, of which 275 belong to the genus Ilex. These are widely distributed, but rare in Europe, the center of distribution being in Central and South America. Ten species are found wild in the northeastern United States. The Aquifoliaceæ are related to the Celastraceæ and the Anacardiaceæ, from which they are distinguished by the absence of the hypogynous disk and by the general appearance.

Ilex Aquifolium of Europe is used there for hedges and for indoor decoration. *I. opaca* is used for indoor decoration in this country. The leaves of both are thick, glossy, evergreen and spiny-toothed. *I. paraguariensis* furnishes maté, which is the tea of South America. It was early cultivated by the Jesuits (1609–1768), and is even yet one of the most important cultivated plants of South America. Other species of Ilex

have been used in various parts of the world for medicine because of their astringent qualities and bitter principle.

Many species of Ilex (Holly, Dahoon, Cassena, Yaupon, Winterberry, Black Alder), and one of Nemopanthus (Mountain Holly) are grown as cultivated plants in America, all for ornamental purposes.

125. **Celastraceæ** (from the genus *Celastrus*, an ancient Greek name). STAFF-TREE FAMILY. Fig. 34. Shrubs or trees, often climbing: leaves alternate or rarely opposite, simple, not lobed: flowers bisexual or unisexual, small and greenish, regular; sepals 4–5, imbricated; petals 4–5, imbricated; stamens 4–5, alternate with the petals, rarely 10; disk present, lining the bottom of the calyx, sometimes adnate to the ovary; ovary superior, 2–5-celled, buried in the disk, or distinct and disk small; 1–2 ovules in each cell; style 1, short; stigmas 2–5-lobed: fruit a drupe, or samara, or a capsule; seeds albuminous, usually with a pulpy aril.

Thirty-eight genera and about 375 species are distributed in all parts of the world except the arctic zone. They are especially numerous in the tropics. Euonymus, Maytenus, and Celastrus are the largest genera. The Celastraceæ are in some respects related to the Cyrillaceæ, in others to the Aquifoliaceæ and Rhamnaceæ. The small greenish flowers, the stamens alternating with the petals, the ovary sunken in the disk, and the aril are in general distinctive. There are exceptions to all these characters.

The capsule of Celastrus and Euonymus frequently remains on the plant through late fall and early winter. It splits into from 3–5 valves, which become reflexed and expose the aril of the seeds. The contrast in color between aril and pericarp is often very striking and ornamental. The Celastraceæ are mostly pollinated by ants and flies which run over the disk for the honey.

The Celastraceæ are of but slight economic importance. Some have been used for their emetic and purgative properties. *Catha edulis* of East Africa has been long cultivated by the Arabs under the name *khat*; the leaves produce an agreeable excitement and it is considered a very valuable remedy for plague. The drupes of an Elæodendron are said to be eaten in South Africa. The wood of some Celastraceæ is much valued for carving.

In North America 6 or more genera of Celastraceæ are grown for ornamental purposes: Elæodendron in warmhouses and in southern parts; Euonymus, hardy North; Gymnosporia and Maytenus grown in southern regions; Pachistima, hardy; and Celastrus, a hardy vine.

126. **Stackhousiaceæ** (from the genus *Stackhousia*, named in honor of John Stackhouse, a British botanist). STACKHOUSIA FAMILY. Fig. 34. Herbs with rather thick, alternate leaves: flowers bisexual, regular, in spikes, racemes or fascicles; sepals 5, imbricated; petals 5, more or less, perigynous, long-clawed, the claws separate below, connate above; disk thin, clothing the inside of the cup-shaped receptacle; stamens 5, perigynous, alternating with the petals, often unequal; ovary superior, 2–5-lobed, 2–5-celled, each cell 1-ovuled; styles 2–5, free or connate: fruit of 2–5 separate, globose, angular, reticulated or winged, indehiscent portions which separate from a central persistent column; seeds albuminous.

This is a very small family of 2 genera and 14 species; natives of Australia and adjacent islands. It is probably related to the Celastraceæ more closely than to any other family.

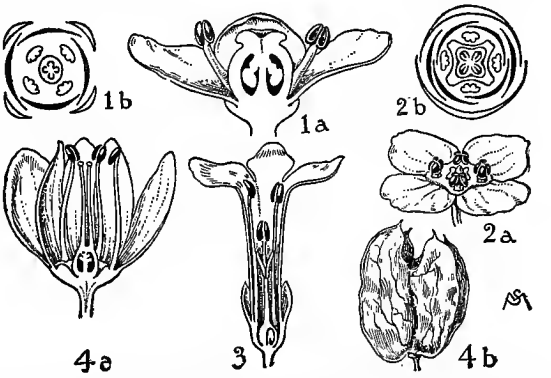
One species of Stackhousia is grown for ornamental purposes in California.

127. **Staphyleaceæ** (from the genus *Staphylea*, derived from the Greek meaning *a cluster*, probably in reference to the flower-cluster). BLADDERNUT FAMILY. Fig. 34. Trees or shrubs: leaves opposite or alternate, pinnately compound, stipulate: flowers bisexual, regular; sepals 5, imbricated; petals 5, imbricated; stamens 5, alternating with the petals, inserted outside the large, cup-shaped disk; ovary usually 3-celled; styles 3, separate or connate: fruit a capsule, often deeply lobed, sometimes indehiscent and berry-like; seeds usually many in each cell, albuminous, sometimes with an aril.

This family contains 5 or 6 genera and about 22 species, in the north temperate zone, extending rarely to northern South America and to the Malay region. Fossil species are known. The family is closely related to the Sapindaceæ, in which it was formerly included, and from which it is separated by the abundant endosperm, the intra-staminal disk, the more numerous seeds, the straight embryo, and various anatomical differences. The fruits of the bladdernut are an inch long, membranous and bladdery; the seeds become loosened and the fruit then is interesting to children as rattle-boxes.

The family is of little economic importance. Three genera are cultivated in North America for ornamental purposes. These are: Euscaphis, Staphylea (Bladdernut), and Turpinia.

128. **Aceraceæ** (from the genus *Acer*, the classical name of the maples, from the Celtic meaning *hard*).



34. AQUIFOLIACEÆ: 1. Ilex, *a*, flower; *b*, floral diagram. CELASTRACEÆ: 2. Euonymus, *a*. flower; *b*, floral diagram. STACKHOUSIACEÆ: 3. Stackhousia, flower. STAPHYLEACEÆ: 4. Staphylea, *a*, flower; *b*, fruit.

MAPLE FAMILY. Fig. 35. Trees or shrubs: leaves opposite, exstipulate, simple or compound: flowers mostly unisexual, often bisexual ones intermixed, regular; sepals 4–5, separate or somewhat connate, imbricated; petals 4–5, or 0, imbricated; disk either extra-staminal or intrastaminal, usually flat, and sometimes lobed or divided; stamens 4–10, mostly 8, separate, inserted at the edge of the disk; ovary superior 2-celled, 2-lobed, much flattened contrary to the partition; style 1; stigmas 2: fruit splitting into two portions, each a samara; seeds 2 in each cell, exalbuminous.

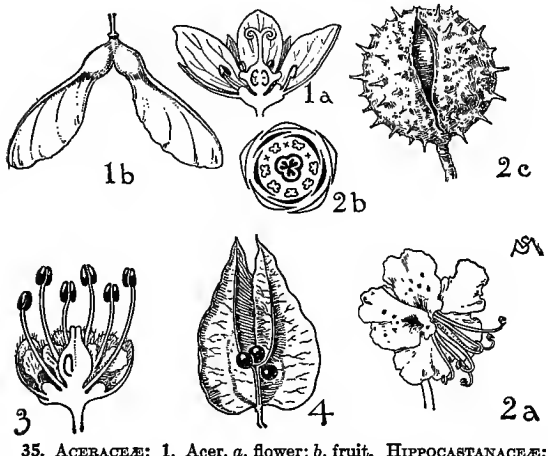
There are 2 genera and about 110 species; all but 1 belong to the genus Acer. They are mostly natives of mountainous or upland countries of the northern hemisphere. Some fossil species have been discovered. The Aceraceæ are closely related to the Sapindaceæ, with which they were formerly united, and from which they differ in the opposite, usually palmate leaves, the peculiar fruit, and regular flowers. In position, the disk shows a transition between the Sapindaceæ and other families. The family is easily recognized by the opposite, exstipulate leaves, and peculiar fruit.

The wood of *Acer saccharum* (sugar maple, hard maple) is of great value for timber. Bird's-eye maple and curly maple are forms of this species in which the growth of the cambium is irregular. The manufacture of sugar from the sap of the sugar maple is an important industry in the northern states in early spring. The sycamore of England is *Acer pseudoplatanus*; that of America is a species of Platanus. The juice of *Acer platanoides* (Norway maple), and probably of others, is milky.

Forty or more species of Acer (maple) are in cultivation in N. America for ornamental purposes. *Acer Negundo* (box elder) is exceptional in having compound leaves.

129. **Hippocastanaceæ** (from the genus *Hippocastanum*, the old generic name of the genus Æsculus, derived from the Greek meaning *horse* and *chestnut*). Horse-Chestnut Family. Fig. 35. Trees or shrubs: leaves opposite, exstipulate, palmately 3–9-foliate: flowers, some bisexual, some staminate, irregular; sepals 5, separate or connate, imbricated; petals 4–5, unequal, clawed; stamens 5–8, separate; disk present, extrastaminal, often inequilateral; ovary 3-celled; ovules 2 in each cell; style and stigma 1: fruit usually 1-celled and 1-seeded, capsular, 3-valved; seeds very large, exalbuminous.

There are 2 genera and 22 species of general distribution in the north temperate zone. The family is closely related to the Sapindaceæ, with which it is often united, and from which it differs only in its larger flowers, palmately compound leaves and large seeds. The Hippocastanaceæ, Sapindaceæ, Melianthaceæ,



35. Aceraceæ: 1. Acer, *a*, flower; *b*, fruit. Hippocastanaceæ: 2. Æsculus, *a*, flower; *b*, floral diagram; *c*, fruit. Sapindaceæ: 3. Sapindus, flower. 4. Kœlreuteria, vertical section fruit.

and some Aceraceæ are almost the only plants with extra-staminal disks.

The horse-chestnut (*Æsculus Hippocastanum*) is a well-known shade tree, said to have been introduced into Europe by Clusius in 1575. The seeds, rich in starch, have been used for fodder. They have also been used to form the principal part of a certain kind of snuff, and the oil contained has been used to a slight extent in medicine. The roots of Æsculus contain saponin and have been used, like soapberry, for washing.

Several species of Æsculus are in cultivation in N. America. *Æ. glabra* and *Æ. octandra*, natives of the central United States, are called buckeyes.

130. **Sapindaceæ** (from the genus *Sapindus*, a contraction of the Latin *sapo-indicus*, Indian soap). Soapberry Family. Fig. 35. Trees or shrubs, rarely herbs, often climbing: leaves usually alternate, mostly compound, sometimes ternately, sometimes pinnately decompound: flowers unisexual or polygamous, regular or irregular (i.e. obliquely unsymmetrical), small; sepals 4–5, imbricated or rarely valvate; petals 4–5, small or wanting, usually with scales or hairs at the base inside; disk well developed, situated between the petals and the stamens (extrastaminal); stamens usually 10 in 2 whorls, more or less united at the base; ovary superior, mostly 3-celled and deeply 3-lobed; ovules typically 1 in each cell; style 1: fruit very diverse, a firm or bladdery capsule, a berry, nut, or winged fruit; seeds without endosperm.

The 118 genera and about 1,000 species are of tropical distribution. Only one species reaches northward as far as Kansas. The family is closely related to the Staphyleaceæ, Hippocastanaceæ, and Aceraceæ, which see for differences; and more distantly to the Celastraceæ. The small flowers, usually appendaged petals, 10 stamens, extra-staminal disk, and 3-celled, few-seeded fruit are usually distinctive.

The climbing Sapindaceæ often have very peculiar stems in which many separate cambium rings have taken part. This renders the cross-section very peculiar, making it appear sometimes as a bundle of woody ropes tied together, with bark between them.

The Sapindaceæ are of considerable economic importance. The fruits of many are used locally for food, sometimes the flesh of the fruit, sometimes the aril being of importance. The seeds of Sapindus and other genera are often roasted and eaten as food. Oil is obtained from the seeds of others. Some are used locally for medicine. The seeds and other parts of many species are very poisonous, the fruits of species of Sapindus being used to poison fish. The juice of *Paullinia pinnata* (cururu) is used by savages in Guiana to poison their arrows. The Lechcheuquana bee collects honey from *Serjania lethalis* which, when eaten even in small quantities, produces raving madness or even death. The bark and berries of many species (e.g., the soap tree, Sapindus) contain saponin which reacts like soap, on which account they are used for washing. Yellow and black dyes, used as cosmetics, are obtained from certain species. The very hard wood of certain Sapindaceæ is much prized for timber. The hard, spherical, black seeds of *Sapindus Saponaria* are strung as beads.

There are 15 or more genera of true Sapindaceæ grown in America. Kœlreuteria (Varnish Tree) is hardy and ornamental. Cardiospermum (Balloon Vine) is a tender annual with queer fruit. Xanthoceras is a hardy ornamental tree. Paullinia is a greenhouse climbing shrub. The following are grown only in the southern states or California: Greyia; Melicocca (Spanish Lime); Blighia (Akee Tree); Dodonæa; Ungnadia (Mexican or Spanish Buckeye); Sapindus (Soapberry).

The following cultivated genera are now referred to other families: Melianthus (Melianthaceæ); Æsculus (Hippocastanaceæ); Acer (Aceraceæ); Ptæroxylon (Meliaceæ); Staphylea (Staphyleaceæ); Euscaphis (Staphyleaceæ); Turpinia (Staphyleaceæ).

131. **Melianthaceæ** (from the genus *Melianthus*, derived from the Greek meaning *honey* and *flower*). Melianthus Family. Shrubs or trees: leaves alternate, entire or pinnate: flowers bisexual, irregular, soon inverted; sepals 5, imbricated; petals 4–5; stamens 4–5, or 10, free or slightly connate at the base, alternating with the petals; disk present, extrastaminal, crescent-shaped, or annular with 10 projections; carpels 4–5; ovary 4–5-celled; ovules 1 to many in each cell; style 1; stigma 4–5-lobed: fruit a capsule; seeds albuminous, sometimes arillate.

All the 3 genera and 17 species are natives of Africa. The Melianthaceæ were formerly united with the Sapindaceæ, with which they agree in the extra-staminal disk, but they differ in the vertically bisymmetrical, not obliquely bisymmetrical, flowers, and more abundant endosperm.

In southern California, species of Melianthus are grown for ornament.

132. **Balsaminaceæ** (from *Balsamina*, the old name of the genus Impatiens, probably derived from *balassan*, the Arabic name of these plants). Balsam Family. Fig. 36. Herbs, very rarely epiphytic: leaves various: flowers bisexual, irregular, spurred, nodding; sepals 3–5, irregular, imbricated often petaloid, the posterior very large and sack-like, and gradually prolonged backward into a honey-spur; petals 5, alternate with the sepals, separate, or united so as to appear as 3, lower petals much the larger; stamens 5, hypogynous, closely

covering the ovary like a hood; anthers coherent; ovary superior, 5-celled; ovules 3 to many in each cell; stigmas sessile: fruit a 5-valved capsule, the valves of which coil up elastically and forcibly distribute the seeds, or sometimes a 5-celled drupe-like structure.

Contained in this family are 2 genera and about 220 species, of which all but 1 belong to the genus Impatiens; widely distributed, but most abundant in the tropics of the Old World, wanting in South America. The family is closely related to the Geraniaceæ, with which it was formerly united, but is distinguished by the 5 peculiar hypogynous stamens. The honey-spur in this family is an outgrowth of the sepals, and not of the receptacle as in Pelargonium and Tropæolum. There are extra-floral nectaries on the foliage of some species, which attract protective ants.

The sap of several species of Impatiens has been used as a dye to color red or yellow: that of *I. biflora* (North America) staining yellow; that of *I. Balsamina* (India) staining red, and used to color the skin and finger-nails. The tubers of *I. tinctoria* of Abyssinia are used for dyeing the feet and hands red or black. Some species have been used as medicine. Many are ornamental.

There are several species of Impatiens in the North American trade: *I. aurea* and *I. biflora* are the east American touch-me-nots or jewel-weeds; *I. Balsamina* is the garden balsam; the other species are greenhouse plants.

Order 40. Rhamnales

133. **Rhamnaceæ** from the genus *Rhamnus*, the old Greek name). Buckthorn Family. Fig. 36. Trees or shrubs, rarely herbs, sometimes spiny or climbing: leaves simple, mostly alternate: flowers bisexual or unisexual, regular, perigynous, small, greenish, mostly axillary; sepals 5, rarely 4, valvate; petals 5, or 4, alternate with the sepals; stamens of the same number as the petals and opposite them; an intrastaminal disk lining the cup-shaped receptacle; ovary 2–4-celled, superior or inferior; cells 1-, rarely 2-, ovuled; styles 2–4, more or less connate: fruit drupaceous, or winged, or capsular.

Rhamnaceæ has 46 genera and about 550 species very generally distributed over the earth. Rhamnus is the largest genus (70 species), and the most widely distributed. The family is represented by 6 native species in northeastern North America. It is most closely related to the Vitaceæ and Celastraceæ, differing from the former in the simple entire leaves and strongly perigynous flowers, and from the latter in the stamens being opposite the petals.

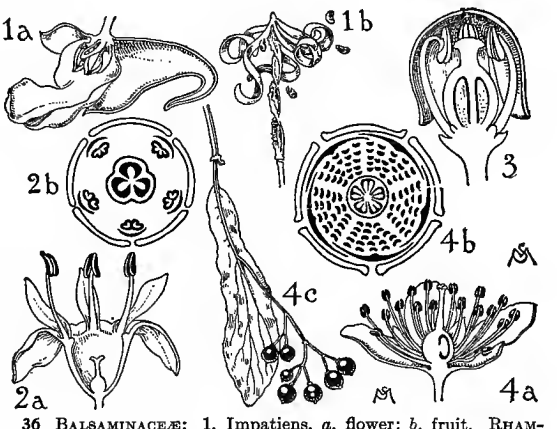
The family is not of great economic importance. The berries and bark of *Rhamnus cathartica* (buckthorn) contain a bitter principle which is purgative. The fruits of some species of Rhamnus yield yellow or green dyes of some importance *R. dahurica* and *R. tinctoria* give Chinese green. The bark of *R. cathartica* and *R. Frangula* (Europe) is used to dye yellow. *R. Purshiana* (California) is the cascara segrada of medicine, a strong purgative. The fruits of *Zizyphus Lotus* are pulpy and agreeable, and were much prized by the ancients. The fruits of several species of Zizyphus are eaten in various parts of the Old World. The spiny branches of *Paliurus Spina-Christi* or *Zizyphus Spina-Christi* are thought to have been those from which the crown of thorns was made.

Nine or more genera are in cultivation in N. America for ornamental purposes. These are: Ceanothus (New Jersey Tea); Berchemia (Supple Jack); Gouania; Hovenia; Paliurus; Pomaderris; Reynosia; Rhamnus (Buckthorn); Zizyphus (Jujube).

134. **Vitaceæ** (from the genus *Vitis*, the classical name). Grape Family. Fig. 36. Mostly climbing shrubs with tendrils, seldom upright shrubs or small trees: leaves alternate or opposite, very diverse: flowers bisexual, or unisexual, small, numerous, regular; sepals 4–5, rarely 3–7, minute or obsolete; petals 4–5, rarely 3–7, valvate, separate (gamopetalous in Leea); stamens 4–5, rarely 3–7, opposite the petals, somewhat perigynous; disk evident. annular or of separate lobes; ovary superior, 2-, rarely 3–6-, celled, with 2, or rarely 1, ovule in each cell; style 1 or 0; stigma capitate or peltate: fruit a berry; seeds albuminous.

The 11 genera and about 450 species are mostly of tropical and subtropical distribution. Fourteen species reach the northeastern United States. The largest genus is Cissus with 250 species. Some fossil forms are known. The Vitaceæ are closely related to the Rhamnaceæ. The climbing habit, the few stamens opposite the petals, the 2-carpelled berry, and the capitate stigma are distinctive.

The petals in Vitis remain connate at the tip as in the bud, but separate from each other at the base, and fall off as a cap. The tendrils of the Vitaceæ are borne at the nodes and opposite the leaves. There has been much discussion as to whether the tendrils are apical or



36 Balsaminaceæ: 1. Impatiens, *a*, flower; *b*, fruit. Rhamnaceæ: 2. Rhamnus, *a*, flower; *b*, floral diagram. Vitaceæ: 3. Vitis, flower. Tiliaceæ: 4. Tilia, *a*, flower; *b*, floral diagram; *c*, fruit.

lateral, i.e., whether the plant is sympodial or monopodial. The tips of the tendrils are in some species expanded into disk-like holdfasts. The species of Cissus are mainly desert plants. They are often cactus-like, with fleshy, angled, jointed, or terete stems; or have tubers or tuberous bases.

The most important economic plant in the family is the grape (Vitis), which has been cultivated since early times. *V. vinifera* is the wine grape of Europe and southern California, and has given rise to our greenhouse grapes; not hardy. *V. Labrusca* is one of the parents of most of our hardy grapes. *V. vulpina* and *V. cordifolia* are frost or fox grapes. Several species of Vitis are grown for ornamental purposes only. Raisins are the dried fruit of certain species of Vitis, mostly *V. vinifera*. Virginia creeper or woodbine (*Parthenocissus* [*Ampelopsis*] *quinquefolia*) and Boston ivy or Japanese ivy (*P. tricuspidata*) are ornamental.

A few genera are in cultivation in America: Ampelopsis; Parthenocissus or Psedera; Cissus (Kangaroo Vine); and Vitis.

Order 41. Malvales

135. **Elæocarpaceæ** (from the genus *Elæocarpus*, derived from the Greek meaning *olive-fruit*). Elæocarpus Family. Trees or shrubs, with entire alternate or opposite leaves without slime-cells: flowers usually bisexual, regular, hypogynous; involucre 0; sepals 4–5, separate or connate, valvate; petals 4–5, or 0, separate, rarely connate, usually valvate, often incised; stamens many; anthers opening by terminal pores; hypogy-

nous intra-staminal disk present; ovary superior, 2- to many-celled, rarely 1-celled; ovules many in each cell; style 1; stigmas 1 to several: fruit capsular or drupaceous.

Seven genera and about 120 species are distributed in the tropics of both hemispheres. Elæocarpus contains 60 species and Sloanea 44 species. The family is closely related to the Tiliaceæ, with which it is often united and from which it is distinguished by anatomical characteristics, and usually also by the often hairy and firm, or incised, petals, or by the absence of petals.

A vegetable ivory used in carving is obtained from the large stone of the drupe of *Elæocarpus sphæricus* of India. Those of *E. tuberculatus* (India and Java) are worn as amulets. The seeds of *Sloanea dentata* of Guiana are eaten like chestnuts. The bark of *Crinodendron Patagua* of Chile is used for tanning. The wood of *Aristotelia Maqui* of Chile is variously used. Its leaves are medicinal and its berries are edible.

Two genera are cultivated in North America: Aristotelia, California; Elæocarpus, not hardy.

136. **Tiliaceæ** (from the genus Tilia, the ancient Latin name of the Linden). LINDEN or BASSWOOD FAMILY. Fig. 36. Trees, shrubs, or herbs: leaves mostly alternate, entire or variously lobed: flowers bisexual, regular; sepals 5, rarely 3 or 4, free or connate, usually valvate; petals as many as the sepals, convolute or imbricated, or valvate, rarely wanting or modified; stamens 10 or more, hypogynous, usually very numerous, filaments separate, or connate only at the base, or in 5–10 fascicles, some may be staminodia; anthers 4-celled, opening by slits or pores; ovary superior, 2–10-celled; ovules 1 to several in each cell; style 1; stigma rayed: fruit a capsule, or indehiscent and nut-like, or a drupe, rarely a berry, or separating into drupelets; seeds usually albuminous.

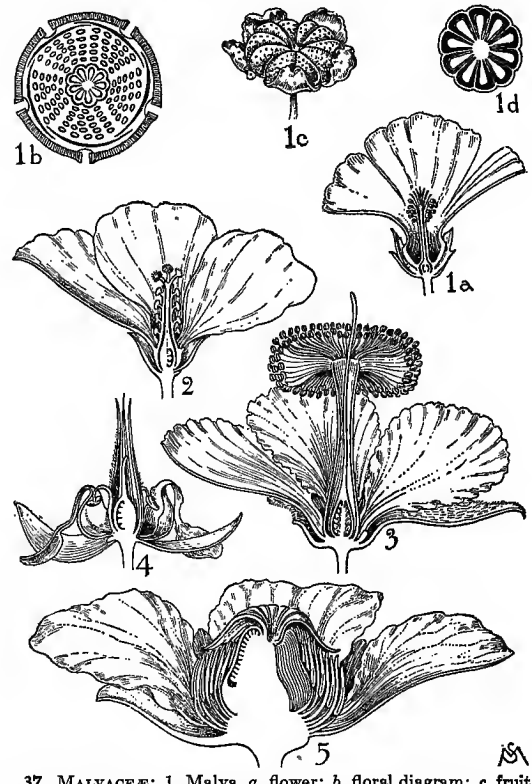
Most of the 35 genera and 270 species are tropical. The most important extra-tropical genus is Tilia (linden, basswood), which is widely distributed. Fossil species are known. The Tiliaceæ are related to the Malvaceæ and Sterculiaceæ, from which they are distinguished by the nearly distinct stamens, and 4-celled anthers. The stamens are sometimes borne, along with the ovary, on a long stipe-like projection of the receptacle, sometimes cover the whole surface of a discoid receptacle, and sometimes are enveloped by the petals.

The Tiliaceæ, like the Malvaceæ, are mucilaginous. For this reason, many have been used more or less in medicine. The genus Tilia and other arborescent genera furnish very valuable timber; that of *Grewia asiatica* is flexible and used for bow-making. In the tropics the foliage of *Corchorus olitorius* is used as a pot-herb. The fruits of species of Grewia are used in India as a sherbet because of their agreeable juice. Some members of the family yield cordage. The beautiful seeds of many species are made into necklaces by the Indians.

In North America 6 or more genera are in cultivation. They are all warmhouse plants, or are grown in southern California, except the Tilias (Basswood, Lime, Linden), of which many species are grown in America. The Tilias furnish some of our best-known hardy, ornamental trees. Other genera are: Entelea, Luehea, Grewia (with some half-hardy species), and Sparmannia.

137. **Malvaceæ** (from the genus *Mallow*, altered from the Greek, in allusion to the mucilaginous emollient qualities). MALLOW FAMILY. Fig. 37. Herbs, shrubs or trees, with alternate, simple, usually palmately veined leaves: flowers bisexual, regular; sepals 5, often united, valvate, frequently bracteolate at the base; petals 5, convolute, often adnate to the stamens; stamens very numerous, hypogynous, the filaments united into a tube (monadelphous), anthers 1-celled, pollen spiny; ovary superior, 2 to many-celled, rarely 1-celled; ovules in each cell 1 to many; styles and stigmas usually as many as the carpels: fruit a capsule or separating into drupelets, very rarely fleshy.

The Mallows include 39 genera and from 800 to 900 species, distributed over the whole earth, except in the arctic zone, but most abundant in tropical America. The Malvaceæ are closely related to the



37. MALVACEÆ: 1. Malva, *a*, flower; *b*, floral diagram; *c*, fruit; *d*, cross-section fruit. 2. Hibiscus, flower. BOMBACACEÆ: 3. Adansonia, flower. STERCULIACEÆ: 4. Theobroma, flower. DILLENIACEÆ: 5. Dillenia, flower.

Sterculiaceæ and Tiliaceæ. From the former they are distinguished by their 1-celled anthers and rough pollen, and from the latter by their monadelphous stamens as well as the 1-celled anthers. The hollyhock-like flower is characteristic.

The foliage, stems, and seeds of most Malvaceæ contain abundant mucilage for which, in some countries, they have been used as medicine. Pungent and poisonous properties are apparently wanting. *Althæa officinalis* (marsh mallow of Europe), *Malva sylvestris* and *M. rotundifolia*, both of Europe, have been used as emollients. *Hibiscus Sabdariffa* and *H. digitatus* (white and red ketmies of tropical Africa) have acid juice and are used in the preparation of refreshing drinks. The capsule of *H.* (*Abelmoschus*) *esculentus* (okra or gumbo) of the tropics is eaten in soup, or cooked and seasoned. The seeds of *H. Abelmoschus* of India, now widely cultivated in the tropics, are used for perfumery. *H. Rosa-sinensis* (Chinese hibiscus or shoeblack plant) contains a coloring matter in the flower with which the Chinese blacken shoes and eyebrows. *Althæa cannabina* of southern Europe has fibers which may be used in place of hemp. The fibers of *Urena lobata*, *Abutilon indicum*, Sida, *Hibiscus cannabinus*, *H. tiliaceus*, and others, are also used. The most useful genus is Gossypium (cotton) of Egypt, India, and tropical America, the abundant, long, woolly hairs on the seeds of which furnish the cotton of commerce. Cotton seed yields an oil which is used for fuel, cattle-food, soap, artificial butter, and many other purposes. Several mallows are weedy plants.

Many of the genera in cultivation in N. America are among the most important old-fashioned cultivated garden plants. Among these are: Abutilon (Indian Mallow, Velvet Leaf); Althæa (Marsh Mallow, Hollyhock); Callirhoë (Poppy Mallow); Gossypium (Cotton); Hibiscus (Bladder Ketmia, Roselle, Jamaica Sorrel, Okra, Gumbo, Rose of Sharon, Mountain Mahoe, Shoeblack Plant); Malope; Malvastrum; Pavonia; Sida; Sphæralcea.

138. **Bombacaceæ** (from the genus *Bombax*, from the Latin meaning *silk* or *cotton*). BOMBAX FAMILY. Fig. 37. Trees: leaves mostly alternate, entire or digitate, often with slime-cells and stellate hairs: flowers bisexual, regular or slightly irregular; involucre often present; sepals 5, separate or connate, valvate; petals 5, twisted in the bud; stamens 5 to many, separate or monadelphous; anther cells 1–2 or more; pollen smooth; staminodia often present; ovary superior, 2–5-celled; ovules 2 to many; style 1; stigmas 1–5: fruit dry or fleshy, dehiscent or indehiscent.

There are 20 genera and about 100 species, of tropical distribution, mostly in America. The family is closely related to the Malvaceæ and often united with that family. It is distinguished most easily by the smooth pollen and the often several-celled anthers.

Many Bombacaceæ are very large trees. The trunk of the baobab tree, or monkey's bread tree (*Adansonia digitata*) of tropical Africa is often 100 feet in circumference. The wool produced in the fruit is of little value. The fruit of *Durio zibethinus* contains a cream-like substance and is eaten. The seeds of the green fruit of *Matisia cordata* of the Andes is edible. The sour cucumber tree or cream of tartar tree is *Adansonia Gregorii*. The fruit contains tartaric acid.

Five or 6 genera are in cultivation in this country in the South and in greenhouses: Adansonia (Boabab Tree, Monkey's Bread); Bombax (Silk Cotton Tree); Chorisia (Floss-silk Tree); Eriodendron; Pachira.

139. **Sterculiaceæ** (from the genus *Sterculia*, derivation obscure). STERCULIA FAMILY. Fig. 37. Trees, shrubs, or herbs, sometimes vines: leaves alternate, simple or digitate: flowers bisexual or unisexual, usually regular; sepals 3–5, somewhat united, valvate; petals wanting or reduced; stamens very remarkable and wonderfully diverse, in 2 whorls, those opposite the sepals reduced to staminodia or wanting, the 1 to many others united into a tube, the anthers frequently alternating with sterile teeth, or variously arranged on the back of the tube; ovary superior, 4–5-celled; ovules several; styles 4–5, distinct or connate: fruit dry, rarely fleshy, or splitting into separate berries.

The 48 genera and about 750 species are almost entirely confined to the tropics. The family is related to the Malvaceæ in the monadelphous stamens, but differs in the 2-celled anthers; also related to the Bombacaceæ and Tiliaceæ. The valvate sepals, reduced petals, 4–5-celled ovary, and especially the peculiar stamens, are distinctive.

The Sterculiaceæ, like the Malvaceæ, contain abundant mucilage. They also contain a bitter principle which renders them emetic and stimulant. The seeds of *Theobroma Cacao*, native of central and northern South America, furnishes cocoa, chocolate, and cocoa-butter. *Cola acuminata* of Africa furnishes the cola nut, now very popular as an ingredient in a mildly stimulating drink. It is said to form the main constituent of the drink called "coco-cola."

There are about 12 genera in cultivation in America, all either in tropical agriculture or in greenhouse culture: Rulingia, Reevesia, and Pterospermum in southern California; Sterculia (Japanese Varnish Tree, Chinese Parasol Tree, Flame Tree), Fremontia and Guazuma in the South; Theobroma and Cola in the West Indies; Abroma, Dombeya, and Mahernia (Honey Bell) mostly in the greenhouse. All are grown for ornamental purposes except Theobroma and Cola.

Order 42. PARIETALES

140. **Dilleniaceæ** (from the genus *Dillenia*, in honor of John James Dillenius, a professor of botany at Oxford). DILLENIA FAMILY. Fig. 37. Trees or shrubs, often climbing: leaves alternate, very rarely opposite: flowers bisexual, regular, hypogynous; sepals 5, rarely more or fewer, imbricated, persistent; petals 5 or fewer, imbricated, deciduous; stamens numerous, often very numerous, free or united in groups, anthers opening by slits or pores; carpels several, usually distinct, but often united; ovules numerous: fruit a follicle, or a berry or a capsule, or inclosed in a fleshy calyx, which simulates a berry; seed albuminous, usually with an aril.

Nearly all the 11 genera and about 200 species are tropical, distributed chiefly in Australia, India, and tropical America, rarely in Africa. Of these Dillenia, Hibbertia and Tetracera are the largest genera. The family is related to the Ranunculaceæ and Magnoliaceæ on the one hand, and to the Theaceæ on the other. Its closest affinity is with the latter family. The woody habit, polypetalous flowers, very numerous stamens, usually separate carpels, albuminous seeds with arils, and straight embryo, are characteristic.

The Dilleniaceæ are astringent, for which reason some are used medicinally; the fruits of some are eaten because acid, others are used as tonics. Davilla of Brazil has been used for wounds; Curatella for ulcers; *Tetracera aspera* of Guiana as a sudorific and diuretic, also for syphilis, intermittent fevers and scurvy. The astringent bark of a species of Dillenia is said to have been used in Asia for ulcerated sores. The acid and inedible fruit of *Dillenia speciosa* serves to season dishes; and a syrup of the juice of the unripe fruit allays coughs, assists expectoration and is said to cure angina; the bark is also used for tanning. Many species of Dillenia furnish timber in the Indo region. The rough, silicious leaves of many of the tribe Tetraceræ, especially *Curatella americana*, have been used in Brazil to polish wood in place of sandpaper. Some of the climbing species furnish drinking-water by incisions in the stem.

The flowers of many species are very beautiful, but few forms are in cultivation. In this country the only one apparently is *Dillenia indica*, a large magnolia-like tree with flowers 9 inches in diameter, grown in southern California and in Florida.

By recent authors (Gilg, in Engler and Prantl), Actinidia, a genus of vines from eastern Asia, has been placed in this family, although formerly included in the Theaceæ. A few species of Actinidia are in the American trade.

141. **Ochnaceæ** (from the genus *Ochna*, which is from *ochne*, the Greek name of a wild pear tree; the resemblance is probably in the foliage). OCHNA FAMILY. Fig. 38. Shrubs or trees, with alternate, simple or pinnate, coriaceous leaves: flowers bisexual, regular; sepals 4–5, imbricated, rarely 10; petals 5, rarely 3–4, or 10, usually convolute; stamens 1–3 times the number of the petals, sometimes with 1–3 series of staminodia, hypogynous, separate; anthers usually opening by terminal pores; an hypogynous stipe usually present (gynophore); ovary 4–5-celled, often deeply lobed; ovules 1 to many in each cell; style and stigmas 1–5:

38. OCHNACEÆ: 1. Ochna, fruit. TERNSTRŒMIACEÆ: 2. Gordonia, flower. 3. Thea, floral diagram.

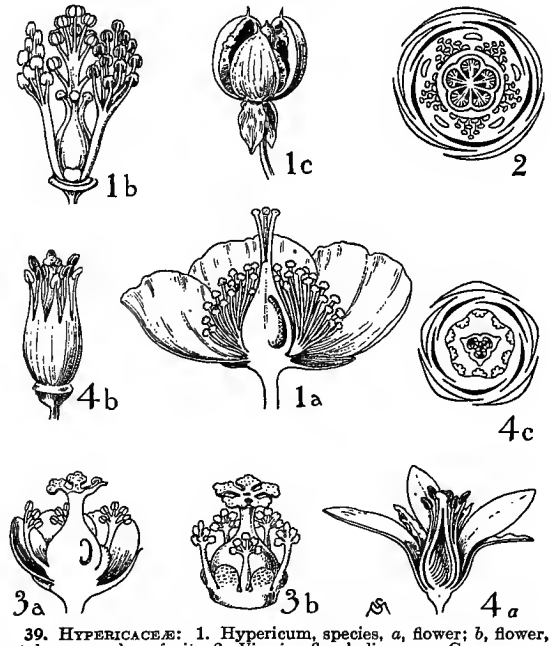
fruit coriaceous and indehiscent, or fleshy, or a capsule, or composed of the 1-seeded drupe-like lobes of the ovary which are whorled on the enlarged fleshy receptacle (Ochna).

The family has 17 genera and 100 or more species, distributed in the tropical regions of both hemispheres, most abundant perhaps in Brazil, but also abundant in Africa. The family is not closely related to any other but seems to stand between the Ranunculus group and the Hypericum group of families. The many sepals, petals and stamens, the gynophore, and usually the lobed ovary, are distinctive.

The wood of some species of Ochnaceæ has been used locally for timber, and, because of the pronounced astringent properties of some species, they have been used locally for fly-bites, ulcers, and so on.

Ochna multiflora, of Upper Guiana, is cultivated in America. This is grown occasionally in greenhouses because of the peculiar fruit, for an account of which see the article on Ochna.

142. **Ternstrœmiaceæ** (or **Theaceæ**) (from the genus *Ternstrœmia*, in honor of Ternstroem, a Swedish naturalist and traveler who died in 1745). TEA FAMILY. Fig. 38. Large or small trees, with alternate, entire, leathery leaves: flowers solitary or scattered, usually bisexual, regular; sepals 5–7, imbricated, persistent; petals 5, rarely 4 or more, nearly or quite separate; stamens very many, rarely 15 or fewer, usually hypogynous, separate or united at the base, or in 5 fascicles, usually adnate to the corolla below; ovary superior, 2–10-celled; ovules 1 to many in each cavity; styles as many as the cells of



39. HYPERICACEÆ: 1. Hypericum, species, *a*, flower; *b*, flower, petals removed; *c*, fruit. 2. Vismia, floral diagram. GUTTIFERÆ: 3. Garcinia, *a*, flower; *b*, flower, perianth removed. TAMARICACEÆ: 4. Tamarix, *a*, flower; *b*, flower, perianth removed; *c*, floral diagram.

the ovary, or united into one: fruit a capsule or indehiscent, dry or drupaceous; embryo more or less curved.

In this family are 16 genera and 174 species of tropical and subtropical distribution. Stuartia reaches Virginia and Kentucky, and Gordonia reaches Virginia. This family is related to the Hypericaceæ and Guttiferæ, also to the Dilleniaceæ. From it are now usually excluded several genera which were formerly included. Of importance to us in this connection are Actinidia (transferred to the Dilleniaceæ), and Stachyurus (transferred to the Stachyuraceæ). The very numerous stamens, the type of ovary and the curved embryo are distinctive. The numerous stamens have probably been produced by the splitting up of one set of 5, as in the Hypericaceæ.

Various glucosides and alkaloids are found in the foliage, on account of which Gordonia has been used for tanning leather, and other species have been used in medicine. The most important species is *Thea chinensis* (tea). The bitter taste of tea is largely due to a glucoside, and the stimulating properties to an alkaloid, theine.

Exclusive of Actinidia and Stachyurus, 8 or 10 genera are in cultivation in N. America. Stuartia and Gordonia (Loblolly Bay) are hardy. Visnea, Ternstrœmia and Cleyera are grown in Florida. Eurya and Schima are Camellia-like warmhouse shrubs. Camellia (Thea) is a famous genus of old-fashioned greenhouse shrubs.

143. **Guttiferæ** (from the Latin signifying *drop-bearing*, in allusion to the resinous exudation). GARCINIA FAMILY. Fig. 39. Trees or shrubs, with opposite or whorled, rarely alternate leaves: flowers regular, usually some bisexual and others unisexual on the same plant, rarely all bisexual; styles usually united and stigmas sometimes shield-shaped,—otherwise as in the Hypericaceæ, to which family it is closely related, and with which the Guttiferæ is united by many authors.

Thirty-five genera and about 370 species inhabit the tropical regions of both hemispheres. Clusia (America), with 80 species, and Garcinia (Old World), with 150 species, are the largest genera. Many species are tropical trees of majestic size and handsome form, useful for timber. The Clusias are mostly epiphytic shrubs with aërial roots and evergreen leaves.

The Guttiferæ yield a yellow or greenish resinous juice when incisions are made. Gamboge is an intensely yellow resinous pigment extracted from *Garcinia Morella* (Ceylon). It is also a powerful purgative. The blackish bitter juice of *Clusia rosea* (West Indies) is also a purgative. The juice of species of Clusia (West Indies) may be used as a varnish. The resin of *C. flava* (hog-gum) is a wound remedy. Wounded swine smear themselves with the gum by rubbing against the plant, hence the name. The pulpy fruit of *Garcinia Mangostana* ("mangosteen" of the Moluccas), and *Mammea americana* (West Indies) are delicious to many people.

There are 3 or 4 genera in cultivation in warm America: Garcinia including the Mangosteen, cultivated in the West Indies, and the Gamboge Tree cultivated in the West Indies and Florida; Calophyllum, cultivated in southern Florida and southern California; *Mammea americana* (Mammee Apple or St. Domingo Apricot), cultivated in southern Florida and southern California.

144. **Hypericaceæ** (from the genus *Hypericum*, an ancient Greek name of unknown origin). ST. JOHN'S-WORT FAMILY. Fig. 39. Herbaceous or woody plants: leaves opposite or whorled, often pellucid punctate or black-punctate: flowers bisexual, regular, cymose; sepals 4–5, more or less connate, the outer smaller, rarely 4, with the 2 outer much larger; petals as many as the sepals, sessile or clawed; claw naked or with a honey-furrow or -pit; stamens many, hypogynous, usually in 3–5 bundles the members of which are often more or less united, rarely monadelphous; ovary superior 3–5-, rarely 1-, celled; placentæ usually parietal; ovules numerous; styles 1–5, usually 3–5: fruit a capsule, rarely fleshy.

About 8 genera and 260 species are known, of which 200 are in the genus Hypericum, of the tropical and temperate regions throughout the world, but especially abundant in the north temperate zone. The family is very closely related to the Guttiferæ, with which it is united by Engler and Prantl under the latter name; also related to the Ternstrœmiaceæ (Theaceæ). The fascicles of stamens probably represent individual stamens, each of which has become divided into many.

The opposite pellucid-dotted leaves, fascicled stamens, and 3–5-celled ovary with separate styles are characteristic.

The balsamic exudations from the bark and wood, especially of the shrubby species, were formerly used to some extent in medicine as an astringent.

The genera in cultivation in America for ornamental purposes are: Ascyrum (St. Andrew's Cross, St. Peter's-wort), and Hypericum (St. John's-wort). Some of the species are herbaceous and some are shrubby. Some of the Hypericums are very showy.

145. **Tamaricaceæ** (from the genus *Tamarix*, said to have been named from the river Tamaris, now Tambro, on the border of the Pyrenees). Tamarisk Family. Fig. 39. Shrubs or small trees, with alternate, mostly needle-like or scale-like, ericoid leaves: flowers bisexual, regular; sepals 4–5; petals 5, imbricated, withering and drying persistent; stamens equal to and alternate with the petals or double the number, inserted on a more or less evident disk; ovary superior, 1-celled, with 3–4 parietal placentæ, or placenta basal; ovules 2 to many; styles 3–4, or stigmas sessile; seeds densely bearded at distal end, rarely winged: fruit a capsule, sometimes becoming falsely and incompletely several-celled.

The 5 genera and about 90–100 species are mainly distributed in the Mediterranean region and in central Asia. The family is related to the Frankeniaceæ and Elatinaceæ; possibly also to the Salicaceæ. The ericoid habit, withering-persistent petals, definite stamens, 1-celled ovary and bearded seeds are distinctive. By means of small leaves, sunken stomata, water-storing tissue, and other contrivances, the Tamaricaceæ are adapted for life in the dry saline regions in which they live. Foliage-glands excrete an excess of absorbed mineral matter, and this very hygroscopic excretion accumulates on the surface of the plant.

The Tamaricaceæ contain much tannin, resin and oils, which render them bitter and astringent. The bark of *Myricaria germanica* has been used for jaundice; the galls of some species are used because astringent. *Tamarix mannifera*, "which grows on Mount Sinai and elsewhere in Arabia, secretes, as the result of the puncture of a cynips, a saccharine matter, supposed by some to be the manna which fed the Hebrews in the desert." (See also *Fraxinus Ornus*.)

None of the genera in cultivation in N. America is very hardy: Tamarix (Tamarisk); Myricaria, all grown for the queer, fluffy foliage, and small, abundant flowers.

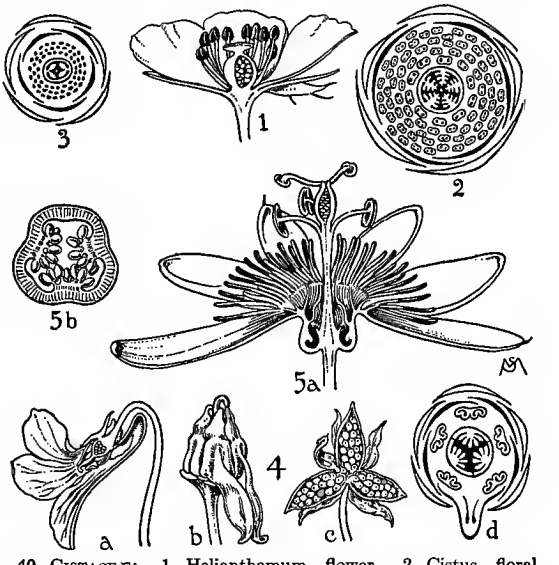
146. **Fouquieriaceæ** (from the genus *Fouquieria*, named in honor of Pierre E. Fouquier, professor of medicine at Paris). Candlewood Family. Similar to the Tamaricaceæ and formerly united with that family, but differing in the gamopetalous corolla, the ligule-bearing, hairy stamens, partially united styles, median ovules instead of basal, and leaves without crystal glands or epidermal glands.

The single genus and about 4 species are natives of Mexico and the southwestern United States.

F. splendens is the ocotilla, coach-whip cactus, vine cactus, or Jacob's staff of the Southwest, a spiny cactus-like shrub used by the Mexicans to make impenetrable hedges. A useful wax is obtained from the cortex of this species. The cortex is also used medicinally. This species is in cultivation in the larger rockeries of California.

147. **Cistaceæ** (from the genus *Cistus*, derived from the Greek, meaning a *box* or *capsule*, on account of the shape of the capsule). Rock-Rose Family. Fig. 40. Herbs or shrubs: leaves mostly opposite: flowers bisexual, regular; sepals 3 or more, in $\frac{2}{5}$ phyllotaxy; petals 5, rarely 3 or 0, quickly falling; convolutions of corolla and calyx in opposite directions; stamens numerous, hypogynous; ovary superior, 1-celled, with 3–10 parietal placentæ, or falsely 5–10-celled by ingrowing partitions; ovules 2 to many, orthotropous; style 1; stigmas 1–3: fruit a capsule.

In North America and around the Mediterranean Sea, 4 genera and about 70 species are distributed; also a few species in eastern Asia and in South America. The family is most closely related to the Violaceæ and the Bixaceæ, and more distantly to the Hypericaceæ. The quickly falling convolute petals, many



40. Cistaceæ: 1. Helianthemum, flower. 2. Cistus, floral diagram. Bixaceæ: 3. Bixa, floral diagram. Violaceæ: 4. Viola, *a*, flower; *b*, flower, perianth removed; *c*, fruit; *d*, floral diagram. Passifloraceæ: 5. *a*, flower; *b*, cross-section of ovary.

hypogynous stamens, 1-celled, many-seeded ovary, parietal placentæ and copious endosperm are distinctive features.

In the dry region about the Mediterranean, the shrubby forms, especially *Cistus ladaniferus* and *C. monspeliensis* take part in forming extensive "maquis," or impenetrable evergreen thickets, where they alone form great stretches of vegetation. The Cistaceæ prefer dry, sunny, sandy or alkaline soil. In America, Hudsonia forms carpets on the sand-dunes which are often strikingly beautiful when in flower. The family includes also Lechea (pinweed), and Helianthemum (rock-rose).

In North America several species of Cistus, all shrubs, and of Helianthemum, are grown for ornamental purposes, although they have no marked importance in this country.

148. **Bixaceæ** (from the genus *Bixa*, a name of South American origin). Bixa Family. Fig. 40. Trees or shrubs: leaves alternate, simple or compound: flowers unisexual or bisexual, regular; sepals 4–5, imbricated; petals 4–5, large and colored, imbricated and twisted in the bud; stamens numerous; anthers opening by slits, or rarely by pores (Bixa), hypogynous; carpels 1 to several, united; ovary 1-celled, with 1 to several parietal placentæ, or falsely 3-celled; seeds many, with endosperm: fruit fleshy or dry, indehiscent or valvular, in Bixa large and bristly-prickly all over.

All the 4 genera and 19 species (excluding the Flacourtiaceæ and other small families often here included) are tropical, from Mexico to Brazil and in Africa, Madagascar and Australia. Bixa is now widely distributed through the tropics. The Bixaceæ are related to the Violaceæ and Cistaceæ, as well as to the Tiliaceæ. The numerous stamens, compound but 1-celled ovary with many placentæ are all important distinguishing characters.

Bixa Orellana furnishes the coloring matter known as "anatto," extracted from the pulp around the seeds,

which is much used to give butter a rich yellow color and is also used in dyeing silks. The Caribbeans formerly tatooed themselves with this dye in order, it is said, to prevent mosquito-bites. The wood is very soft and serves only for tinder; the roots are aromatic and have been used to color and flavor soups. *Maximilianea Gossypium* furnishes a substitute for gum tragacanth in farther India.

Bixa Orellana is in cultivation in the West Indies, where it is grown for the fruit. Several other genera in the American trade, which were formerly included in the Bixaceæ, are now placed by Warburg in the Flacourtiaceæ.

149. **Violaceæ** (from the genus *Viola*, the ancient Latin name). VIOLET FAMILY. Fig. 40. Herbs, shrubs or small trees, rarely climbing: leaves usually alternate: flowers bisexual, regular or irregular; sepals 5, separate or nearly so; petals 5, 1 often spurred; stamens 5, hypogynous or slightly perigynous, closely connivent around the style, similar or dissimilar (2 spurred); ovary 1-celled; placentæ 2–5, usually 3, parietal; ovules many; style 1: fruit a firm capsule with placentæ on the middle of the valves, rarely a berry and indehiscent.

Violaceæ has 15 genera and about 300 species, of which about 200 belong to the genus Viola. These genera are grouped in three tribes: the Violeæ, with irregular flowers, found chiefly in Europe, Siberia and North America, although the woody species are mainly natives of tropical America; the Paypayroleæ and Rinoreeæ, with regular flowers, are principally found in South America, Africa and Australia. The family is closely related to the Cistaceæ. The tendency to irregular flowers, the peculiar stamens, the 1-celled ovary with usually 3 parietal placentæ, and the anatropous ovules, are distinctive.

In the genus Viola and some other genera, a finger-like curved nectar-secreting horn projects backward from the connective of each of the two lower anthers into the spur of the lower petal. In many species of Viola, almost all the seeds are produced by small apetalous cleistogamous flowers on short pedicels near the ground in midsummer, after the normal flowering period is over. These are very fertile, and quite diverse in structure, and, therefore, useful in classification. Cleistogamous flowers are also produced in the genus Hybanthus. The capsules of most Violaceæ open elastically when ripe, the valves springing back and at the same time folding on the midrib so that the seeds are forcibly ejected as one would shoot a wet apple seed from between the fingers.

The Violaceæ have been used to a certain extent in medicine, their virtues being due to an alkaloid having emetic and laxative properties. *Hybanthus ipecacuanha* ("white ipecacuanha" of commerce) furnishes a substitute for ipecac. Various species of Viola and other genera have been used in many countries for skin diseases, as emetics, laxatives, and the like. Several species are ornamental.

Three genera are in the American trade: Corniostylis or Calyptrion, a species of greenhouse woody climbers; Hybanthus or Solea, of the garden; and Viola (Common Pansy, Horned Pansy, Sweet English Violets, Wild Violets).

150. **Flacourtiaceæ** (from the genus *Flacourtia*, named in honor of E. de Flacourt, a governor of Madagascar). FLACOURTIA FAMILY. Trees or shrubs, rarely climbing: leaves usually alternate and in 2 ranks: flowers bisexual, rarely unisexual, regular; sepals 2–6, commonly 4–5, imbricated, rarely otherwise; petals 0, or equal to the sepals, or many, imbricated or convolute; stamens numerous, hypogynous or perigynous; receptacle enlarged and variously modified, often surmounted by a diversely formed disk; ovary superior or nearly so, 1-celled; placentæ parietal; ovules numerous; styles and stigmas 1 to several: fruit dry or fleshy, dehiscent or indehiscent.

There are 70 genera and more than 500 species of tropical distribution. The family is related to the Violaceæ, Passifloraceæ, and other families with similar parietal placentation, but is most closely related to the Bixaceæ with which it has often been united, and from which it differs mainly in the absence of slime-cells. In general, the peculiar ovary, the numerous stamens, the regular flower, and the enlarged receptacle are characteristic.

The sour fruit of several species is eaten, or preserved, in the tropics. The seeds of *Pangium edule* are roasted and used for baking. The leaves of *Casearia esculenta* are eaten in India. The wood is little used. The bark of *Neumannia theiformis* is used like ipecac in Madagascar. Chaulmugra oil is obtained probably from *Gynocardia odorata* of farther India. A peculiar resin is secured from species of Lætia of Cuba. Coccos oil, used in perfumery, is obtained from the Polynesian genus Myroxylon. The fixed oil of species of Pangium is used in cooking.

Probably 5 or 6 genera are in cultivation in the warmer parts of North America: Aberia (Kei Apple); Azara; Carrieria; Flacourtia (Rambustan, Governor's Plum); Idesia, hardy in Mass.; Oncoba; Xylosma.

151. **Stachyuraceæ** (from the genus *Stachyurus*, signifying *spike-tail*, in reference to the form of inflorescence). STACHYURUS FAMILY. Shrubs or small trees with alternate leaves: flowers bisexual or polygamous, regular; sepals 4, imbricated; petals 4, imbricated; stamens 8, separate; carpels 4; ovary superior, 1-celled, or falsely 4-celled by the intrusion of the large parietal placentæ; style and stigma 1; ovules many: fruit berry-like, pericarp leathery.

Only one genus and 4 species occur in Japan, China, and the Himalayas. The family is closely related to the Ternstrœmiaceæ with which it was formerly united and from which it differs in the fewer stamens, 1-celled ovary and entire stigma. Useful apparently only as ornamental plants.

Two species are occasionally cultivated in America.

152. **Passifloraceæ** (from the genus *Passiflora*; early travelers thought they had found emblems of the crucifixion in the flower, for a detailed account of which see article Passiflora). PASSION-FLOWER FAMILY. Fig. 40. Herbaceous or woody plants, usually climbing by axillary tendrils: leaves alternate, simple or compound: flowers bisexual, or unisexual, usually involucrate, perigynous; calyx and corolla sometimes similar; sepals 4–5, imbricated, often petaloid; petals 4–5, rarely 0, imbricated, often smaller than the sepals, sometimes fringed; a crown (outgrowth of receptacle) of many filaments between the petals and stamens, sometimes tubular or scale-like; stamens 4–5, usually opposite the petals, inserted on the edge of the cup-shaped receptacle, or at the base of the corona, or at the base of the pistil at the summit of a long gynophore, separate or connate; ovary superior, raised on a more or less distinct stalk (gynophore), 1-celled with 3–5 parietal placentæ; ovules numerous; styles 3–5: fruit a berry or capsule.

This family contains 18 genera and about 350 species, inhabitants principally of the tropical regions, especially of the New World. Two hundred and fifty species belong to the genus Passiflora, which extends as far north as southern Pennsylvania. The family is not closely related to other families, but finds its nearest affinities in the Loasaceæ, Turneraceæ and Begoniaceæ. The remarkable floral structure is distinctive.

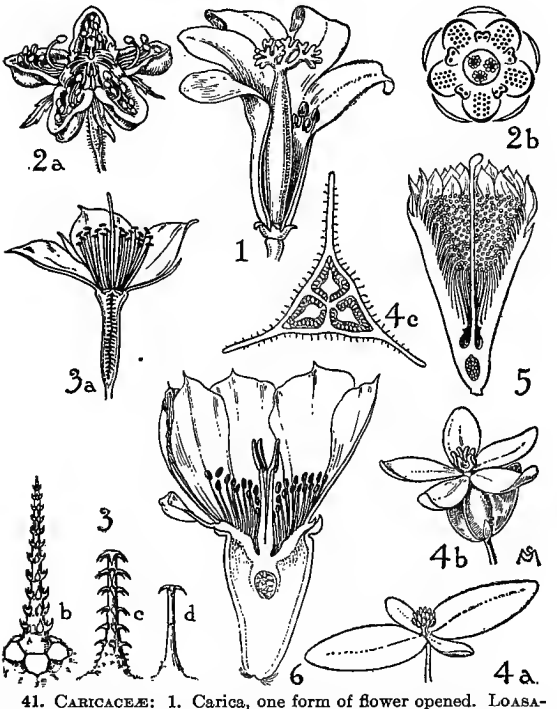
The pulpy aril of the seeds of Passiflora is used in tropical America in the preparation of cooling drinks. The flowers and fruit of *P. rubra* are narcotic. The roots of *P. quadrangularis* are very poisonous and sometimes used in small doses as a vermifuge. Many Passifloras are cultivated in the tropics as fruit plants.

Many are in cultivation in America, namely Passiflora and Tacsonia (Granadilla, Jamaica Honeysuckle,

Water Lemon, May-Pop), some for the beautiful and odd flowers, some, especially in the South, for the fruit.

153. **Caricaceæ** (from the genus *Carica*, erroneously supposed to be a native of Caria; or from the Latin meaning a kind of dry fig). PAWPAW FAMILY. Fig. 41. Peculiar trees with straight, rarely branched, palm-like trunks, very abundant milky juice, and a terminal crown of very large, alternate, palmately-lobed, rarely entire, leaves: flowers unisexual, small, nearly regular; sepals 5; petals 5, in the staminate flowers connate, in the pistillate nearly separate; stamens about 10, inserted on the corolla; ovary superior, 1- or 5-celled, many-seeded; styles 5: fruit a large melon-like berry.

This is a small family of 2 genera and 27 species, confined to tropical and subtropical America; most abundant in the Andes. The Caricaceæ is united with the Passifloraceæ by some authors, but is similar only in



41. CARICACEÆ: 1. Carica, one form of flower opened. LOASACEÆ: 2. Loasa, *a*, flower; *b*, floral diagram. 3. Mentzelia, *a*, flower; *b*, *c*, and *d*, types of foliage hairs. BEGONIACEÆ: 4. Begonia, *a*, male flower; *b*, female flower; *c*, cross-section ovary. CACTACEÆ: 5. Pilocereus, flower. 6. Opuntia, flower

the fruit. It is also related to the Cucurbitaceæ by the fruit. The peculiar habit and abundant milky juice are very distinctive.

The large melon-like fruits of *Carica Papaya* are now cultivated and eaten throughout the tropics; those of other species are also eaten. The milky juice of *C. Papaya* contains a pepsin-like substance which will curdle milk. This substance will separate the fibers of meat, and hence the leaves and fruit are cooked with too fresh tough meat to make it tender. The juice has also been used as a remedy for dyspepsia.

Carica Papaya (South American pawpaw) is commonly grown in greenhouses; and it, as well as two other species, are grown in southern California and Florida in the open.

154. **Loasaceæ** (from the genus *Loasa*, the meaning unknown). LOASA FAMILY. Fig. 41. Erect or climbing herbs, rarely shrubby, with very peculiar and characteristic hairs, some hooked, some stinging: leaves opposite or alternate, very diverse: flowers bisexual, regular, mostly perigynous (i.e., receptacle usually extended beyond the ovary); sepals 4–5, imbricated; petals 4–5, flat or cucullate; stamens 4–5, alternating with the petals, or more commonly very numerous through doubling, the outer often converted into staminodia which resemble the petals; ovary usually inferior, and 1-celled, with 3 parietal placentæ; ovules numerous: fruit a capsule, rarely indehiscent, often spirally constructed.

There are 13 genera and about 120 species confined to America from the Great Plains to Chile; most abundant in South America. This is a distinct family distantly related to the Passifloraceæ and the Begoniaceæ. The very peculiar hairs constitute a good recognition character. On Mentzelia there are three types of hairs: (1) Chinese pagoda-like, broad at the base; (2) tuberculate stem and harpoon-like top; (3) smooth stem and harpoon top. The flowers with many staminodia are often large and cactus-like. Very queer, grotesque, complex scales are produced in the flowers of certain genera (e. g., Loasa) through the union of several staminodia.

Mentzelia hispida is a strong purgative, and is used by the Mexicans for syphilis.

A few genera are in cultivation in North America. Of these, Loasa is like a nettle, and the sting is very painful, but the flowers are queer and interesting. Mentzelia comprises a number of garden annuals or biennials often with large showy flowers.

155. **Begoniaceæ** (from the genus *Begonia*, named in honor of Michael Begon, a French promoter of botany). BEGONIA FAMILY. Fig. 41. Herbs, rarely shrubby, hairs usually scale-like or branched: leaves alternate, usually oblique: flowers monœcious, regular, epigynous, cymose, the staminate opening first; perianth of the staminate flowers of 2 valvate sepals and 2 petals, all petaloid; perianth of the pistillate flowers of 2 to many similar petaloid parts; stamens numerous, separate or nearly so; ovary inferior, 2–3-celled, usually sharply angled and winged; ovules numerous; styles 3, more or less branched and bearing very peculiar crescent-shaped, kidney-shaped, or, more often, spiral, velvety stigmas, rarely straight: fruit a capsule, rarely a berry.

The Begonia family has 4 genera and about 500 species, most of which belong to the genus Begonia. They are widely distributed throughout the tropics, but perhaps most abundant in South America along the Andes to Mexico, and in the eastern Himalayas southeastward to the Malay Peninsula. The Begoniaceæ constitute a distinct group remotely related to the Cactaceæ, Loasaceæ, Passifloraceæ and Cucurbitaceæ.

The family is of little economic importance except for ornamental purposes. Many species contain oxalic acid and are eaten as salad, and as a remedy for scurvy. The roots of some are astringent; others have a purgative root, used in certain tropics for syphilis and scrofula. The Begoniaceæ is one of the most important ornamental families.

Very many species and hybrids of Begonia are grown for greenhouse and bedding purposes, both for the flowers and the foliage.

Order 43. OPUNTIALES

156. **Cactaceæ** (from the old Linnæan genus *Cactus*, a name used by the ancients to denote any spiny plant). CACTUS FAMILY. Fig. 41. Fleshy plants with watery or milky juice, a great reduction or complete absence of foliage, and very thick, rather sparingly branched, rarely unbranched stems, which are cylindrical, globular, flattened, or fluted, and often constricted or jointed: leaves alternate, flat and leaf-like in Pereskia, scale-like or absent in other genera, usually bearing bundles of spines in the axils, which are trichomes, and which are of two kinds, long and stout, or minute and needle-like: flowers bisexual, mostly regular, perigynous or epigynous; sepals and petals rarely 8–10, usually very many, similar; stamens many, inserted spirally or in groups

on inside of the receptacle; ovary inferior, 1-celled, with 3 to many parietal placentæ; ovules numerous; style 1; stigmas as many as the placentæ: fruit a berry; embryo straight or curved.

The Cacti are almost entirely confined to the dry regions of tropical and subtropical America. Mexico is the center of this distribution, but the Cactaceæ extend from New York to Patagonia. A species of Rhipsalis has lately been found indigenous in West Africa. The family is related to the Begoniaceæ, Loasaceæ, and Passifloraceæ. The peculiar habit, perianth of many similar parts, many stamens, and inferior 1-celled ovary are distinctive. The Cactaceæ is divided into three groups: (1) Cereus group, with receptacle extended in a tube beyond the ovary (perigynous), and no hooked spines; (2) Opuntia group, tube of the receptacle wanting, hooked spines usually present; (3) Pereskia group, with foliaceous leaves, panicled flowers, and no hooked spines.

The seeds of Rhipsalis, an epiphytic genus, are often viscid so as to adhere to tree trunks and the like. The ovaries of some Cactaceæ are imbedded in the tissue of the stem. In this family, the thick stem is a water-storing organ. The flatttened or fluted condition of the stem of most species is probably an adaptation which allows these stems to swell when water is abundant and contract when it is scarce without danger of rupturing the cuticle. The variation in size and form among cacti is very great. The largest species is *Carnegiea giganteus* of Mexico, candelabra-like, 60 feet high.

The fruit of *Opuntia Ficus-indica*, now naturalized in the Mediterranean region, is there eaten under the name of Indian fig. *Opuntia Tuna* of tropical America is the prickly pear, an edible fruit. *Opuntia vulgaris* of the eastern United States is also eaten under the name of prickly pear or Indian fig. Fruits of *Cereus triangularis*, *C. giganteus*, and *C. Thurberi* are much prized. The stem and flowers of *C. grandiflorus* are used in medicine, producing an action on the heart. Vermifugal properties are found in many Cactaceæ. An alcoholic drink is made by the Mexicans from the sap of species of Cereus. The cochineal insect, a scale insect yielding the well-known dye, cochineal, lives upon species of Opuntia, Pereskia, and Nopalea, in tropical America.

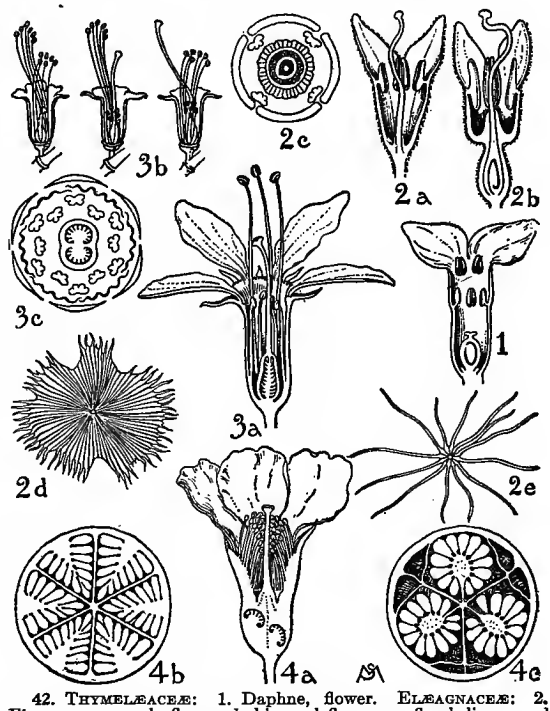
The total number of genera of Cactaceæ which have been described up to the present time is about 70, although Dr. Karl Schumann, who monographed the family in 1899, recognized but 21. Of the many genera described, most are good and will probably stand. A rational and uniform treatment of the family will doubtless show that there are no less than 75 tenable genera. The total number of names published is something over 3,800. This includes many species that have been transferred from one genus to another. The number of species recognized by Schumann is something less than 700. Many of these species of Schumann, however, are known to be aggregates, and it is not unlikely that there are about 1,200 species in the family.

The number of genera treated in this work is 35. They are in cultivation in America as odd plants for desert gardens, and as greenhouse curiosities. Many have beautiful showy flowers, those of *Cereus grandiflorus* (night-blooming cereus) being nearly one foot across, and opening only in the night.

The reader will find the cacti described in this Cyclopedia under the following names: Acanthocereus; Anhalonium = Ariocarpus; Aporocactus; Ariocarpus; Bergerocactus; Cactus; Carnegiea; Cephalocereus; Cereus; Disocactus; Echinocactus; Echinocereus; Echinopsis; Epiphyllum = Zygocactus; Escontria; Hariota; Harrisia; Heliocereus; Hylocereus; Lemaireocereus; Leptocereus; Leuchtenbergia; Lophophora; Mamillaria; Melocactus = Cactus; Myrtillocactus; Nopalea; Opuntia; Pachycereus; Pelecyphora; Pereskia; Pereskiopsis; Phyllocactus = Epiphyllum; Pilocereus = Cephalocereus; Rathbunia; Selenicereus; Schlumbergera; Wilcoxia; Wittia; Zygocactus.

Order 44. Myrtifloræ

157. **Thymelæaceæ** (from the generic name *Thymelæa*, a Greek name meaning *thyme* + *olive* or *oil*). Mezereum Family. Fig. 42. Shrubs or trees, rarely herbs: leaves alternate or opposite, simple, entire: flowers bisexual or unisexual, regular, receptacle developed into a long tube which bears appendages in the throat; perianth undifferentiated, often petaloid, parts 4–5, imbricated, perigynous; stamens as many as the sepals and alternate with them, or twice as many, or



42. Thymelæaceæ: 1. Daphne, flower. Elæagnaceæ: 2. Elæagnus, *a*, male flower; *b*, bisexual flower; *c*, floral diagram; *d* and *e*, hairs from surface of leaf. Lythraceæ: 3. Lythrum, *a*, flower; *b*, trimorphic flowers of *L. Salicaria*; *c*, floral diagram. Punicaceæ: 4. Punica, *a*, flower; *b*, fruit, upper story; *c*, fruit, lower story.

reduced to 2, perigynous; ovary superior, 1-celled, rarely 2-celled; ovule solitary, pendulous; style 1 or 0, stigma 1: fruit indehiscent, a nut, drupe, or berry; rarely a capsule.

About 37 genera and 425 species are widely distributed over the earth. One species is native in northwestern North America. The largest genera are Gnidia with 80–90 species, and Pimelea with 75 species. The family stands between the Myrtifloræ and the Cactales, and also somewhat suggests the Passifloraceæ. The single perianth, the tubular receptacle, perigynous, definite stamens, the appendages in the tube of the receptacle, and the superior 1-celled, 1-ovuled ovary are distinctive.

Gnidia carinata of South Africa and *Daphne Mezereum* (mezereon) of Europe have been used as a purge; as has also the spurge flax (*Daphne Gnidium*) of South Europe, the caustic juice of which is used in a blistering ointment. A blistering principle is obtained from the bark of *Funifera utilis* of Brazil; also from *Dirca palustris*. The roots of *Thymelæa tinctoria* yield a yellow dye. Paper is made from the cauline fibers of

several species, e.g., *Daphne cannabina* of India, *Dirca palustris* of the United States, Gnidia of Madagascar, and Lagetta of Jamaica. Cord is made from *Lagetta funifera* and *L. lintearia* of South America. The wood of *Aquilaria Agallocha* of India is aromatic, called aloewood. One Pimelea yields a balsam. Lace-bark is the product of *Lagetta lintearia*.

Six or more genera are in cultivation in this country for ornament. Among these are: Daphne (Mezereon), greenhouse and garden; Dirca (Leatherwood, Moosewood), native, hardy; and Pimelea (Rice Flower), greenhouse.

158. **Elæagnaceæ** (from the genus *Elæagnus*, derived from the Greek name of the olive combined with that of the Chaste tree). OLEASTER FAMILY. Fig. 42. Trees and shrubs, covered with silvery and brown, peltate or stellate scales: leaves alternate or opposite, simple, entire: flowers bisexual or unisexual, regular, perigynous; receptacle developed into a long tube beyond the ovary, more or less persistent, and inclosing the fruit; perianth of 1 series; parts 4, rarely 2 or 6, valvate; stamens of the same number or double the number, inserted in the tube; perigynous disk prominent, lobed; ovary superior, 1-celled, 1-ovuled; style 1; stigma 1: real fruit dry, indehiscent, but appearing drupe-like because of the fleshy investing receptacle.

Three genera and about 30 species are found, of which about 25 belong to Elæagnus; mostly steppe or rock plants, chiefly of south Asia, Europe and North America. The family is closely related to the Thymelæaceæ, which see for further relationship. The peculiar scales, the perigynous flowers, the 1-celled, 1-seeded ovary, and the fleshy but free receptacle are distinctive.

The acid fruits of *Elæagnus angustifolia* of Persia are eaten; also those of *E. latifolia* of India, and the seeds of *Shepherdia argentea* of North America.

There are 3 genera in cultivation in America, principally as hardy ornamental plants with silvery foliage: Elæagnus (Oleaster, Goumi); Hippophaë (Sea Buckthorn, Swallow Thorn); Shepherdia (Buffalo Berry).

159. **Lythraceæ** (from the genus *Lythrum*, derived from the Greek meaning *blood*, in reference to the purple flowers). LOOSESTRIFE FAMILY. Fig. 42. Herbs, shrubs, or trees: leaves usually opposite or whorled: flowers bisexual, usually regular, perigynous; receptacle ("calyx-tube") tubular, ribbed, free from the ovary, bearing the 4 or 8 valvate sepals on its margin; petals of the same number as the sepals, or 0, and inserted with them, imbricated; stamens usually twice as many as the petals, rarely more (up to 200), or fewer (to 1); outer set alternate with the petals, and inserted some distance below them; ovary superior, 2–6-celled, many-ovuled: fruit a capsule, rarely indehiscent.

There are 22 genera and about 450 species known; generally distributed, but more abundant in the tropics, especially in America. The largest genus is Cuphea with about 160 species. The family is closely related to the Onagraceæ, but differs in the superior ovary; it is also related to the Melastomaceæ, but the stamens are normal.

Lythrum Salicaria has been used as an astringent; Heimia and Cuphea have been used as purgatives and emetics. *Lawsonia inermis* of Egypt is the famous henna, the perfume of the flower of which is renowned throughout the East; with an orange-red dye obtained from the leaves of this plant, women of the orient dye hair and nails. *Pemphis acidula* is used as a pot-herb in Asia. The flowers of *Woodfordia floribunda* yield the red dye of India called dhak. Lagerstrœmia furnishes very valuable timber.

In cultivation in N. America are several genera: Cuphea, species of garden annuals; Decodon (Swamp Loosestrife), native, but used for water-gardens; Lythrum (Loosestrife); Lawsonia (Henna), cultivated in southern Florida and southern California; *Lagerstrœmia indica* (Crape Myrtle) cultivated in the South.

160. **Punicaceæ** (from the genus *Punica*, derived from the Latin in reference to Carthage, near which city the plant is said to have grown; or from the Latin meaning *scarlet*, in reference to the flowers). POMEGRANATE FAMILY. Fig. 42. Shrubs or commonly small trees: leaves mostly opposite: flowers bisexual, usually perigynous; receptacle campanulate or tubular, thickened above the ovary; sepals 5–8, fleshy, valvate; petals 5–7, imbricated, inserted with the sepals on the edge of the receptacle; stamens very numerous, clothing the tube of the receptacle; carpels in 1–2 (rarely 3) superimposed series, 3 in the lower and usually 5–7 in the upper; ovary more or less inferior, with as many cells as carpels; placentæ of the lower series axile, of the upper parietal, the cells many-ovuled; style and stigma 1: fruit a berry, the pulpy central mass of which is formed from the fleshy outer seed-coats.

This is a family of only 1 genus and 2 species, natives of the Mediterranean region and eastward to the Himalayas. It was formerly united with the Lythraceæ, but the peculiar ovary is unique. *Punica Granatum* is the famous pomegranate, cultivated for its fruit since the earliest times, and now widely spread over the tropics. This species is cultivated in the southern states and in greenhouses. It has escaped in Florida.

161. **Lecythidaceæ** (from the genus *Lecythia*, derived from the Greek meaning an *oil-jar*, in reference to the fruit). LECYTHIA FAMILY. Fig. 43. Trees: leaves alternate, large and striking: flowers bisexual, regular, perigynous or epigynous; sepals 4–6, rarely fewer, valvate; petals 4–6, imbricated, rarely more or fewer; stamens very numerous, somewhat monadelphous, many antherless; intra-staminal disk often present; ovary inferior, 2–6-celled, several ovules in each cell: fruit a hard-shelled berry or a capsule dehiscing by a lid.

The family has 18 genera and about 225 species, with a somewhat isolated distribution in various parts of the tropics, e.g., North Brazil, west coast of Africa, Malay Peninsula, Mozambique, and Samoa. The family was formerly united with the Myrtaceæ but is dissimilar in some important details of vascular structure, and in the absence of volatile oils.

The most important economic plant is the Brazil-nut or para-nut (*Bertholletia excelsa*) of northern South America, the oily seeds of which are an important article of food. The seeds are in a box-like capsule, the lid of which falls off. The oily seeds of several other species are eaten, e.g., the monkey-pot tree (Lecythis). The fruits and roots of a number of species of Barringtonia are used in Java and China to stupefy fish. The flowers of *Grias cauliflora* of the West Indies are used for tea. A cooling drink is made from the fruit of *Couroupita guianensis* of the West Indies.

The Brazil-nut or nigger-toe is sparingly planted in southern California, Florida and the West Indies.

162. **Rhizophoraceæ** (from the genus *Rhizophora*, *root-bearing*, because of the numerous aërial roots). MANGROVE FAMILY. Fig. 43. Trees or shrubs: leaves usually opposite, coriaceous: flowers bisexual, epigynous or perigynous; sepals 3–14, more or less connate, valvate; petals of the same number, small, often lacerate; stamens 2–4 times as many, often in pairs opposite the petals; ovary inferior, usually 2–5-celled: fruit somewhat juicy, crowned with the calyx, rarely dehiscent, usually a berry, rarely a drupe.

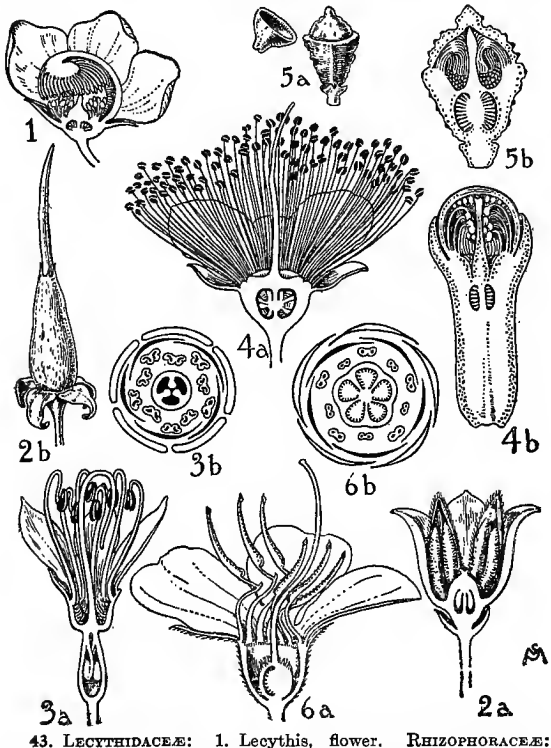
The 15 genera and about 50 species are distributed throughout the tropics. The family is related to the Combretaceæ and Lythraceæ; more distantly to the other families of the myrtaceous group.

This is a small family of remarkable plants, mostly inhabiting mud-flats along the coast in the tropics. The stem soon perishes at the base and then the plant is supported by its numerous prop-roots alone. The mud is so soft that otherwise the plants could probably not remain erect. The genus Rhizophora is almost unique in the vegetable kingdom because the seeds germi-

nate on the plant. The hypocotyl may reach the length of 3 feet, although usually less; it is club-shaped and heaviest at the apex, so that when the seedling eventually falls from the tree, it sticks in the mud vertically, with the hypocotyl down, ready to grow.

The Rhizophoraceæ are of little economic importance. Land is held in place and protected from the waves by the mangrove. The fruits of Anisophyllum are plum-like but poor. The mangrove grows wild on the Florida, Texas, and Mississippi coast, and has been offered for sale in California.

163. **Combretaceæ** (from the genus *Combretum*, a name given to this plant by Pliny). COMBRETUM FAMILY. Fig. 43. Trees or shrubs, erect or climbing: leaves



43. LECYTHIDACEÆ: 1. Lecythis, flower. RHIZOPHORACEÆ: 2. Rhizophora, *a*, flower; *b*, germinating fruit. COMBRETACEÆ: 3. Combretum, *a*, flower; *b*, floral diagram. MYRTACEÆ: 4. Jambosa, *a*, flower; *b*, vertical section flower-bud. 5. Eucalyptus, *a*, flower-bud and lid; *b*, vertical section flower-bud. MELASTOMACEÆ: 6. Melastoma, *a*, flower; *b*, floral diagram.

alternate or opposite, simple or coriaceous: flowers bisexual or unisexual, regular, usually perigynous; receptacle enveloping the ovary and often projecting into a slender tube; sepals 4–5, valvate, connate; petals 4–5, or 0; stamens 4–5, alternating with the petals, or twice or thrice as many; ovary 1-celled, inferior, 2–4-ovuled: fruit a drupe, or dry and winged, rarely dehiscent.

In this family are 15 genera and about 280 species, mostly confined to the tropics of both hemispheres. The family is related to the Cornaceæ and the Rhizophoraceæ, as well as more distantly to the Onagraceæ.

The trees are valuable for their hard, close wood; the tannin-containing bark and galls are used locally for tanning leather. The seeds known as myrobalans (*Terminalia Chebula* and *T. Catappa*) are much eaten in India. A useful oil is obtained from these seeds. Black and yellow dyes are furnished by several species.

Four to 6 genera are in cultivation in the Southern States and the West Indies. *Terminalia Catappa* (tropical almond, myrobalan) is grown for nuts and shade. Poivrea is a red-flowered shrub grown in southern Florida. One species of Combretum is a warmhouse climbing shrub. Quisqualis, or rangoon creeper, is a peculiar climbing shrub grown in the warmhouse. It is at first erect, later climbing.

164. **Myrtaceæ** (from the genus *Myrtus* derived from the classical name myrtle, which probably meant *perfume*). MYRTLE FAMILY. Fig. 43. Usually shrubby or arborescent aromatically fragrant plants: leaves usually opposite, thick, entire and pellucid-dotted: flowers bisexual, regular, rarely perigynous; sepals mostly 4–5, imbricated; petals 4–5, imbricated; stamens very numerous by splitting, often in fascicles which are opposite the petals; ovary inferior, 1- to many-celled: fruit usually a berry, rarely a drupe or nut; seeds 1- to many.

The 72 genera and 2,750 species are confined almost entirely to the tropics, but with two great centers of distribution, one in tropical America and the other in Australia. Eugenia contains 625 species, and Eucalyptus more than 130 species. This is a large family related to the Melastomaceæ, Onagraceæ, and Lythraceæ. The very numerous stamens, derived by the splitting of the few original stamens, and the oil-glands are distinctive. The petals of Eucalyptus remain firmly grown together, and, when the flower opens, they separate along a transverse line and are thrown off as a lid.

The Myrtaceæ are rich in volatile oils; also in tannin, acids, sugars, mucilage, and fixed oils. Cloves are the flower-buds of *Jambosa caryophyllus*. The fruit of *Pimenta officinalis* is thought to combine the flavors of the nutmeg, cinnamon, and clove, and is therefore termed allspice. *Psidium Guajava* is a tree cultivated in the tropics for the much-prized fruits. Oil of myrica is obtained from the leaves of *Pimenta acris* of the West Indies, and is used in making bay rum. Oil of cajeput, a fragrant oil used in medicine, is secured from the leaves and twigs of the East Indian *Melaleuca Leucadendron*. The leaves of the European myrtle (*Myrtus communis*) yield a distilled preparation known as eau-d'ange, used as a toilet article. Other edible fruits are rose apples (*Jambosa malaccensis* and *J. vulgaris*) of the East Indies and Pacific Ocean. Jambos berries are obtained from *Jambosa vulgaris*, which is extensively cultivated in the tropics. Oil of eucalyptus is an important aromatic oil obtained from the foliage of various species of that genus. The wood of Eucalyptus is hard, firm and elastic, and is much prized in wood-carving Many other species of this family are in use locally for food, condiments, medicine, timber, and so on.

About 20 genera are in cultivation in North America, mostly in the South or Southwest. Among these are the Bottle-brush (Callistemon), Cajaput Tree (Melaleuca), Eucalyptus or Australian Blue-gum, Rose Apple or Jambos (Jambosa), Cayenne Cherry (Eugenia), Myrtle (Myrtus), Guava (Psidium), Allspice, Pimento (Pimenta), Brisbane Box (Tristania), Turpentine Tree (Syncarpia), and Downy Myrtle (Rhodomyrtus).

165. **Melastomaceæ** (from the genus *Melastoma*, derived from the Greek *black-mouth*, because the berries of some of the species when eaten stain the mouth black). MELASTOMA FAMILY. Fig. 43. Herbs, shrubs or trees; erect, climbing or epiphytic: branches often 4-sided: leaves opposite or whorled, simple, mostly entire, usually palmately nerved throughout with transverse nervelets: flowers bisexual, regular or slightly irregular, often perigynous; sepals 3–6, mostly 5, valvate, imbricated or united into a calyptra-like hood; petals commonly 5, convolute; stamens usually twice as many as the petals, rarely just as many; anthers mostly opening by terminal pores, inflexed in the bud, often curved; connective very peculiar and diverse, with various appendages; often one anther cell wanting, the other mounted on the end of the lever-like, versatile, curved connective; ovary usually 4–5-celled, more or

less inferior; ovules numerous in each cell; style and stigma 1: fruit a berry, drupe or capsule, or dry and indehiscent, usually inclosed in the calyx.

Most of the 148 genera and about 2,800 species, are found in tropical America, where the species are very abundant and form a characteristic component of the vegetation; represented in the eastern United States by 4 species of Rhexia (deer-grass, meadow beauty). Melastomaceæ is a very distinct, striking and peculiar tropical family related to the Myrtaceacæ and the Lythraceæ, recognized by the venation of the leaves, and the unusual stamens. The so-called "cauliflower" species, with the flowers borne directly on the tree-trunks, are pollinated by butterflies in the deep tropical forests. Some Melastomaceæ are myrmecophilous, i.e., furnish habitations or food for ants, which in turn protect the plant.

The fruits of several species are eaten. The berries and bark of some yield coloring matter of some importance. A yellow dye is obtained from the leaves of Memecylon of the East Indies and Africa; red and black dyes are secured from the berries of Tamonea (tropical America), Melastoma (East Indies), and so on. The leaves of *Tamonea theæzans* are used by the Peruvians in place of tea. Some, because of astringent properties, are locally used as medicine. The most important use of the Melastomaceæ is ornamental. The large, showy, queer flowers and striking foliage render them popular greenhouse plants in the North.

Some 20 genera are cultivated in N. America, mostly as warmhouse decorative plants, or for summer bedding. Few, if any, have popular names.

166. **Onagraceæ** (from the genus *Onagra*, now a part of Œnothera, derived from the Greek, *a wild ass*, in reference to a fancied resemblance between the ears of that animal and the leaves of these plants). Evening Primrose Family. Fig. 44. Mostly herbs, rarely shrubs: leaves opposite or alternate: flowers bisexual, regular, perigynous or epigynous; sepals 4, rarely 2–3, separate or united, valvate; petals 4, or rarely 2 or 0, mostly clawed, convolute; stamens of the same number as the petals or twice as many, outer alternate with the petals; ovary 2–4-celled, inferior; ovules numerous; style 1; stigmas 1–4: fruit a capsule, rarely a berry or nut.

The 36 genera and 470 species are mostly natives of the temperate portion of the New World (western United States and Mexico), but are also abundant in South America. Epilobium, containing 160 species, is widely distributed in the cooler regions of both hemispheres. This is a distinct family, recognized by the numerical plan of 2 or 4, the usually perigynous flowers, and the inferior ovary with many ovules. It is related to Lythraceæ, Melastomaceæ, Myrtaceæ, and other families of this group.

Fuchsia is shrubby or even arborescent, and its fruit is a berry. The tubular receptacle is prolonged beyond the ovary in most genera, but not in Jussieua, Ludwigia, and Epilobium. The seeds of Epilobium are comose, and are distributed, parachute-like, by the wind. The flowers of a number of species of Œnothera open only at night or in dark weather, and are pollinated by night-flying moths; hence the name evening primrose.

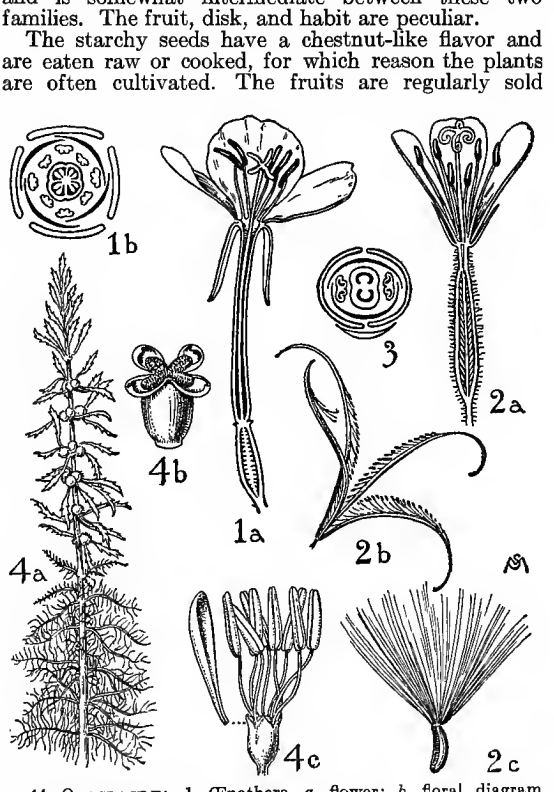
The wood of several species of Fuchsia furnishes ink and a black dye. *Jussieua pilosa* yields a yellow dye. The berries of many Fuchsias are eaten, and preserved with sugar. The young shoots of *Epilobium latifolium* are eaten as greens. The roots of *Œnothera biennis* have been improved in Europe and furnish "rhapontic" roots, which are eaten like celery. The coma of the seeds of Epilobium has been used in Lapland to make lamp-wicks and has been spun into cloth, but without great success. Many genera are cultivated for ornamental purposes because of the showy flowers.

About a dozen genera are cultivated in N. America, among which are the following: Circæa (Enchanter's Nightshade); Epilobium (Willow Herb, Fire Weed); Fuchsia; Ludwigia (Water-purslane, Seed-box or Rattle-box); Clarkia; Œnothera (Evening Primrose, Sundrops); and Godetia. These are mostly grown in the open as annuals or as hardy perennials, except Fuchsia, which is a greenhouse plant but often bedded out in summer.

167. **Hydrocaryaceæ** (from the Greek signifying *water-walnut*). Water Chestnut Family. Herbaceous, aquatic plants, mostly floating: stems slender, clothed with opposite, pinnatifid roots: leaves alternate, crowded at the summit of the stem, floating, rhomboid, petioled; petioles forming thick, hollow floats: flowers bisexual, regular, slightly perigynous, axillary; sepals 4; petals 4; stamens 4, all sets alternating; ovary surrounded by an erect, corona-like disk, half-inferior, 2-celled; cells 1-ovuled; style and stigma 1: fruit a woody 1-celled, 1-seeded nut bearing on the surface the four divergent woody horn-like sepals and capped by the woody disk.

A single genus and 3 species occur, distributed in the Mediterranean region and eastward to eastern Asia. This is an ancient family, more common in the tertiary. The family is related to the Onagraceæ, with which it is frequently united, and to the Haloragidaceæ, and is somewhat intermediate between these two families. The fruit, disk, and habit are peculiar.

The starchy seeds have a chestnut-like flavor and are eaten raw or cooked, for which reason the plants are often cultivated. The fruits are regularly sold



44. Onagraceæ: 1. Œnothera, *a*, flower; *b*, floral diagram. 2. Epilobium, *a*, flower; *b*, dehiscing fruit; *c*, seed. 3. Circæa, floral diagram. Halogragidaceæ: 4. Myriophyllum, *a*, portion of flowering plant; *b*, female flower; *c*, male flower, petals removed.

in the markets of India; those of *Trapa natans* var. *verbanensis* are used as beads.

Trapa natans (Water Chestnut, Water Caltrops) and *T. bispinosa* (Singhara Nut) are grown in this country as aquarium plants. See article on Trapa.

168. **Haloragidaceæ** (from the genus *Haloragis*, meaning *sea* + *a berry*). Water Milfoil Family. Fig. 44. Herbs, aquatic or terrestrial, of very diverse appearance: leaves opposite or alternate, often in the same genus, pectinate (aquatic) to very large and

divided: flowers bisexual or unisexual, regular; sepals 4; petals 4 or 0; stamens 8, the outer opposite the petals, or 4, rarely fewer; ovary inferior, 1–4-celled, each cell 1-ovuled: fruit nut-like, often crowned by the calyx.

Eight genera and about 100 species are known, of general distribution. These are most abundant in the southern hemisphere of the Old World. They are represented in South America and elsewhere by the queer Gunnera and in the eastern United States by Hippuris, Myriophyllum and Proserpinaca. The family is closely related to the Onagraceæ, but differs in having but 1 ovule in each cell of the ovary.

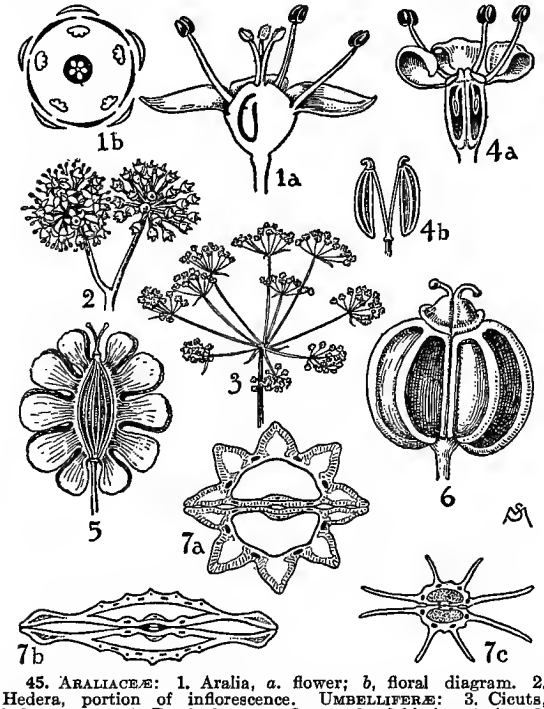
The aquatic forms are Utricularia-like and floating, with slender stems and either finely pectinate leaves with filiform divisions (Myriophyllum) or linear and entire leaves (Hippuris). Gunnera of South America has broad kidney-shaped leaves varying from small to gigantically large. The leaves of this genus in Costa Rica are said to be so large as to give shelter to three men on horseback.

The fruits of *Gunnera macrophylla* are used as a stimulant in Java. The giant leaves, six feet broad, of *Gunnera chilensis* are used in Chile for tanning skins.

Two species of Gunnera are almost, or quite, hardy in the mid-eastern United States, and are grown for luxuriant lawn foliage. Several species of the aquatic Myriophyllum are in cultivation, one of which is parrot's feather (*M. proserpinacoides*).

Order 45. Umbellifloræ

169. **Araliaceæ** (from the genus *Aralia*, the meaning of which is unknown). Ginseng Family. Fig. 45. Herbs, shrubs, or trees, often prickly or climbing: stems solid, pithy: leaves usually alternate, simple, or pinnately or ternately compound: flowers bisexual or unisexual, small, regular, epigynous, commonly in umbels; sepals minute, often almost wanting; petals 5, rarely more, valvate or imbricated, sometimes cohering at the apex and deciduous as a cap; stamens usually 5, alternate with the petals, and inserted at the edge of an epigynous disk, rarely twice or thrice as many; ovary inferior, 2–15-celled; cells 1-ovuled; styles as many as the carpels: fruit a berry, rarely splitting into segments.



45. Araliaceæ: 1. Aralia, *a*. flower; *b*, floral diagram. 2. Hedera, portion of inflorescence. Umbelliferæ: 3. Cicuta, inflorescence. 4. Fœniculum, *a*, flower; *b*, dehiscing fruit. 5. Artedia, fruit. 6. Apium, fruit. 7. *a*, *b*, and *c*, fruits of Umbelliferæ, cross-section.

Fifty-one genera and about 400 species are distributed in tropical and temperate regions of both hemispheres. The two great centers of distribution are tropical America and the Malay Peninsula. The family is very closely related to the Umbelliferæ, but differs in the berry-like fruit with more numerous carpels.

The leaves of the English ivy (*Hedera Helix*) were used in medicine in olden times. The roots of ginseng (*Panax Ginseng* and *Panax quinquefolium*) are much prized in China where they are carried about on the person as a charm against disease. These roots are now extensively and profitably cultivated in America for the Chinese trade. The roots of *Aralia nudicaulis* (American sarsaparilla) are considered a tonic. Chinese rice-paper is made from the pith of *Tetrapanax papyriferum* simply by cutting the pith spirally into thin sheets. Many Araliaceæ are grown as ornamental plants.

Many genera are cultivated in America. Among these are: Acanthopanax; Aralia (including Spikenard, Hercules' Club or Devil's Walking-club, Wild Sarsaparilla, Bristly Sarsaparilla, Chinese Angelica Tree); Dizygotheca; Fatsia; Oreopanax; Polyscias; Pseudopanax; Hedera (English Ivy); and Panax (Ginseng).

170. **Umbelliferæ** (from the predominating type of flower cluster). Parsley Family. Fig. 45. Herbs or rarely shrubs: stems often hollow: leaves alternate, rarely simple, usually ternately or pinnately compound: flowers minute, bisexual, regular or the outer irregular, epigynous, borne in simple or compound umbels; sepals minute or wanting; petals 5, valvate and incurved in the bud; stamens 5, alternating with the petals, inserted around an epigynous disk; ovary 2-celled, inferior, each cell 1-seeded; styles 2: fruit very special, consisting of 2 dry, ribbed or winged, 1-seeded, indehiscent carpels (mericarps), which separate at the base but remain attached at the top to a very slender and flexuous Y-shaped stalk (carpophore) from which they dangle; between or under the ribs are oil-tubes.

About 231 genera and 1,500 species are very commonly found in all boreal temperate and subtropical lands, but are rare in the tropics except in the mountains. The Umbelliferæ is a distinct family, closely related to the Araliaceæ, and more distantly to the Cornaceæ. The umbels, the inferior ovary and the peculiar fruit are distinctive.

The leaves are exceedingly diverse in size, shape and extent to which compounded. Those of Eryngium are sword-shaped, or yucca-like, often spiny; those of Hydrocotyle are simple and often peltate. Azorella of the Andes and New Zealand is turf-like or cushion-like, a xerophytic adaptation. Some species of Angelica are immense herbs many feet high with enormous leaves. The flowers, in general, are uniform in structure and appearance, the greatest diversity being in the fruit.

Economic plants are abundant in the Umbelliferæ; between 40 and 50 have been listed by some authors. Various alkaloids and other compounds, some very poisonous, together with many kinds of resins, produced in the foliage, roots or seeds, form the basis of their economic importance. Plants used for food are celery (*Apium graveolens*), carrot (*Daucus Carota*), and parsley (*Petroselinum sativum*). Those used for flavoring are caraway (*Carum Carui*), anise (*Pimpinella Anisum*), sweet Cicely (Osmorhiza or Scandix), chervil (*Anthriscus Cerefolium*), dill (*Anethum graveolens*), fennel (*Fœniculum vulgare*), lovage (*Levisticum officinale*). Very poisonous plants are poison hemlock (*Conium maculatum*), fool's parsley (*Æthusa Cynapium*) and others. The following drugs are obtained from this family: coriander (*Coriandrum sativum*), ammoniac resin (from *Dorema Ammon-*

iacum), galbanum (a resin from species of Ferula). From various species of Ferula is obtained the vile-smelling gum-resin asafetida, used in medicine, which the Persians are said to praise as a delicious condiment.

There are 40–50 genera in cultivation in America, mostly hardy. Some are grown for food, others for ornament: Sea Holly (Eryngium); Sanicle, or locally Black Snakeroot (Sanicula); Carrot (Daucus); Coriander (Coriandrum); Cumin (Cuminum); Celery (Apium); Caraway (Carum); Gout-weed (Ægopodium); Sweet Cicely (Osmorhiza); Myrrh (not of medicine) or European Sweet Cicely (Myrrhis or, more properly, Scandix); Fennel (Fœniculum); Lovage (Levisticum); Angelica (Angelica); Cow-parsnip (Heracleum). Poison hemlock (Conium) is a roadside weed.

171. **Cornaceæ** (from the genus *Cornus*, derived from the Latin *horn*, referring to the hardness of the wood). Dogwood Family. Trees or shrubs, rarely herbs: leaves opposite or alternate, entire, exstipulate: flowers bisexual, rarely unisexual, regular, epigynous; sepals 4, minute or absent; petals 4, usually valvate; stamens commonly of same number as petals and alternate with them, separate; epigynous disk usually present; ovary inferior, 2-celled, rarely 1–10-celled; ovules in each cell 1, rarely 2: fruit a drupe or berry.

The 15 genera and about 120 species, of which 45 species belong to the genus Cornus, are distributed in the temperate portions of the northern hemisphere, principally in North America and Asia; some, however, occur in South Africa and New Zealand. The relationships of the family are doubtful. Cornus is related to the Caprifoliaceæ, but some other genera suggest the Araliaceæ. The woody or sub-ligneous habit, 4-merous, polypetalous, epigynous flowers and the berry-like fruit with one seed in each cell are distinctive.

Many species of Cornus have capitate flowers surrounded by a large petaloid involucre (e.g., *Cornus mas*, *C. florida*, *C. canadensis*). *C. canadensis* and *C. suecica* are herbaceous dogwoods. *Helwingia rusciflora*, of China and Japan, is a most remarkable plant with flowers borne at the center of the leaf-blade attached to the midrib on the upper side.

The acid fruits of *C. mas* are edible, and are used as a sherbet in the East. Those of *C. capitata* of the Himalayas have a flavor like strawberries and are eaten. Many Cornaceæ are ornamental woody plants.

Several genera are in cultivation here, of which may be mentioned: Cornus (Dogwood, Osier Dogwood); Aucuba, from Japan; Garrya from southern United States; Griselinia from New Zealand; Nyssa (Sour Gum, Pepperidge, Tupelo) from the eastern United States. Garrya, Nyssa and others have been separated by some into other families.

Sub-class II. Metachlamydeæ, or Sympetalæ

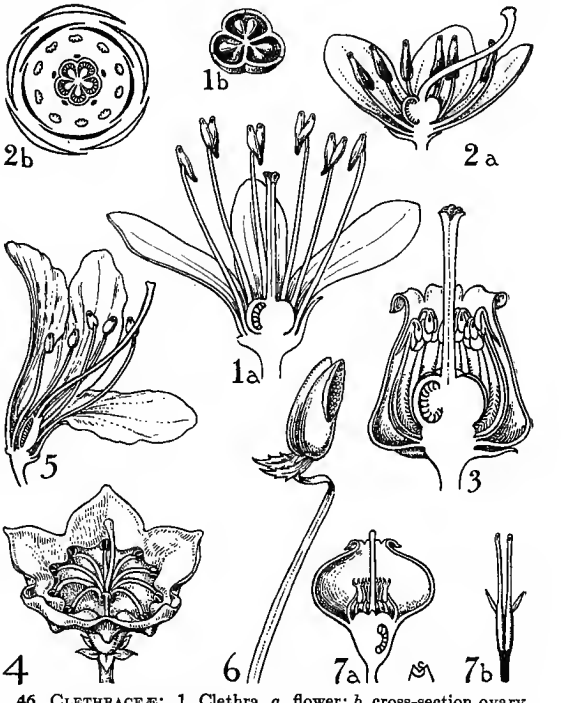
Order 46. Ericales

172. **Clethraceæ** (from the genus *Clethra*, the ancient Greek name of Alder). Pepperbush, or White Alder Family. Fig. 46. Tall shrubs or low trees: leaves alternate: flowers bisexual, regular, hypogynous; disk absent; calyx 5-parted, persistent; corolla saucer-shaped, of 5 separate petals; stamens 10, hypogynous; anthers opening by terminal pores, at first inverted, later erect; ovary superior, 3-celled; style 1; stigmas 3; ovules numerous: fruit a capsule.

A single genus and about 30 species are distributed in the tropical and subtropical regions of both hemispheres; mostly American. Two species reach the eastern United States. The family is closely related to the Pyrolaceæ and Ericaceæ. The polypetalous corolla, temporarily inverted anthers and the 3-celled ovary are important characteristics. There is one fossil species known.

A few species of Clethra are grown in North America for ornamental purposes. *C. alnifolia* is the native white alder or sweet pepperbush.

173. **Pyrolaceæ** (from the genus *Pyrola*, diminutive of Pyrus; possibly a resemblance in the foliage). Shinleaf Family. Fig. 46. Very low perennial herbs:



46. Clethraceæ: 1. Clethra, *a*, flower; *b*, cross-section ovary. Pyrolaceæ: 2. Pyrola, *a*, flower; *b*, floral diagram. Ericaceæ: 3. Andromeda, flower. 4. Kalmia, flower. 5. Rhododendron, flower. 6. Erica, stamen. 7. Vaccinium, *a*, flower; *b*, stamen.

leaves alternate, basal or scattered, thick and evergreen in most species: flowers bisexual, regular, with or without a hypogynous disk; calyx 5-parted, persistent; corolla waxy, saucer-shaped, of 5 separate petals; stamens 10, hypogynous; anthers opening by terminal pores, inverted; ovary superior, 5-celled, many-ovuled; style and stigma 1: fruit a capsule.

There are 3 genera and 20 species distributed in the boreal and temperate parts of Europe, Asia and America. The polypetalous flowers, inverted anthers and 5 carpels are characteristic. The family is closely related to the Ericaceæ and Clethraceæ.

Two species of Chimaphila (Pipsissewa, Prince's Pine), one species of Moneses (One-flowered Pyrola), and a few species of Pyrola (Shinleaf) are offered in the American trade for ornamental purposes. Otherwise the family is of no economic importance.

174. **Monotropaceæ** (from the genus *Monotropa*, meaning *one turn*, in reference to the nodding flower). Indian-Pipe Family. Low, saprophytic herbs, without chlorophyll, white, yellowish, brownish, or blood-red in color: leaves alternate, reduced to scales: flowers 1 to several, bisexual, regular, a lobed, hypogynous disk sometimes present; calyx 5-parted, rarely 0; corolla of 4–5, separate, gibbous petals, these rarely coherent; stamens 8–10, hypogynous; anthers opening by slits, 1–2-celled, often appendaged; ovary 4–5-celled, superior, many-ovuled; style and stigma 1: fruit a capsule.

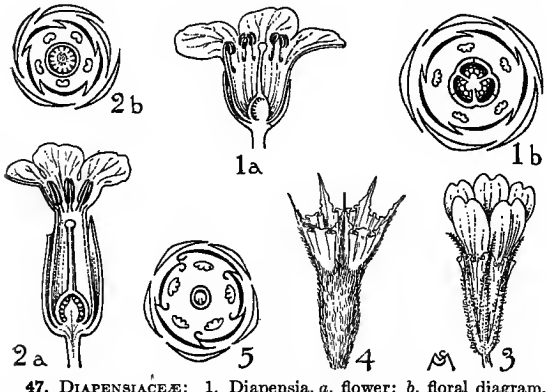
The Indian-pipe family contains 8 genera and about 12 species, all North American except 1 Himalayan species and 1 found in both Europe and America; most abundant in the West. The family is closely related to the Ericaceæ, Pyrolaceæ and Clethraceæ, from which it differs mainly in method of nutrition.

Sarcodes sanguinea, the Sierran snow plant, is bright red in color.

The Monotropaceæ are not known to be in cultivation.

175 **Ericaceæ** (from the genus *Erica*, the ancient name of the heath, from *erico*, to break). HEATH FAMILY. Fig. 46. Shrubs or sub-shrubs: leaves alternate, often evergreen: flowers bisexual, regular or slightly irregular; calyx 4–5-fid, persistent; corolla gamopetalous, rarely polypetalous, often urceolate, 4–5-lobed, convolute or imbricated; stamens alternate with the petals, of the same number or double the number, inserted at the base of a hypogynous disk, not epipetalous; anthers sometimes appendaged, opening by terminal pores, rarely by longitudinal slits; ovary superior or inferior, 4–5-celled or falsely 10-celled, many ovuled; style and stigma 1: fruit a capsule, rarely a berry or drupe.

The 67 genera and about 1,400 species are very generally distributed. Erica, the largest genus, with 420 species, is confined to the Old World. The family is closely related to the Pyrolaceæ and Clethraceæ; also to the Epacridaceæ and Diapensiaceæ. The northern Ericaceæ are largely evergreen and variously adapted



47. DIAPENSIACEÆ: 1. Diapensia, *a*, flower; *b*, floral diagram. PRIMULACEÆ: 2. Primula, *a*, flower *b*, floral diagram. PLUM; BAGINACEÆ: 3. Armeria, flower. 4. Statice, calyx. 5. Plumbago, floral diagram.

in foliage to a xerophytic habitat. Ledum is polypetalous. Rhododendron has a funnel-form corolla; Kalmia, a cup-shaped corolla with elastic stamens in pockets. The anthers of Epigæa dehisce longitudinally.

Arctostaphylos Uva-Ursi (bearberry) of Europe and America is medicinal. The volatile oil of wintergreen is obtained from the leaves, and stems, of the North American *Gaultheria procumbens*. A very poisonous substance is found in some species of Rhododendron, Lyonia and Leucothoë; and possibly the poisonous quality of Kalmia and Rhododendron honey is due to this. Species of Gaylussacia (North America) yield huckleberries; species of Vaccinium yield blueberries. The fruits of *V. Myrtillus* (Europe) are bilberries. The European heaths furnish commercial honey. Cranberries are the fruit of *V. macrocarpon* and *V. Oxycoccus*. Many species of Ericaceæ are ornamental.

Forty to 50 genera are in cultivation in N. America. Among these are the Strawberry Tree or Madrona (Arbutus); Bearberry (Arctostaphylos); Heather (Caluna); Heath (Erica); Trailing Arbutus or Mayflower (Epigæa); Labrador Tea (Ledum); Sourwood or Sorrel Tree (Oxydendrum); Azalea, Rhodora, Rhododendron or Pinxter Flower (Rhododendron); Laurel (Kalmia); Blueberry and Cranberry (Vaccinium); Huckleberry (Gaylussacia); also Menziesia, Chamædaphne, Cassiope, Andromeda, and others.

176. **Epacridaceæ** (from the genus *Epacris*, derived from the Greek meaning on the top; many species growing on hilltops). EPACRIS FAMILY. Shrubs or small trees: leaves alternate, usually stiff, small, and heath-like: flowers bisexual, regular, hypogynous; disk present; calyx of 4–5 sepals, bracted at the base; corolla gamopetalous, 4–5-lobed; stamens 4–5, hypogynous or epipetalous; anthers opening by longitudinal slits; carpels 4–5; ovary superior, 1–10-celled; ovules solitary or many; style and stigma 1: fruit a drupe or capsule.

The 21 genera and about 300 species are almost exclusively confined to Australia and New Zealand. One species is found in South America. The family is closely related to the Ericaceæ, but has one whorl of stamens. The genus Styphelia contains 172 species. *S. sapida* furnishes edible berries.

A few species of Epacris are grown as ornamental plants in the greenhouses of North America.

177. **Diapensiaceæ** (from the genus *Diapensia*, the derivation of which is obscure). DIAPENSIA FAMILY. Fig. 47. Low shrubs: leaves alternate, evergreen, reniform or imbricated or moss-like: flowers bisexual, regular, hypogynous; disk absent; calyx of 3–5 sepals; corolla with 5 separate petals, or gamopetalous; lobes imbricated; stamens 5, epipetalous or hypogynous, alternating with the corolla lobes, often also alternating with 5 staminodia; anthers opening by a longitudinal slit; ovary superior, 3-celled; ovules very numerous; style 1; stigmas 1–3: fruit a capsule.

Diapensiaceæ has 6 genera and about 10 species of circumpolar distribution, extending southward to Carolina and the Himalayas. The family is related to the Ericaceæ, and to the Epacridaceæ. The 3 carpels and 5 stamens are important distinguishing characteristics.

Four or more genera are in cultivation in America; of these, *Galax aphylla* (Galax) of North Carolina has reniform leaves; *Pyxidanthera barbulata* (Pyxie, Flowering Moss, or Pine-barren Beauty) of southern New Jersey has subulate leaves; Shortia, of North Carolina and Japan, and *Schizocodon soldanelloides* (Fringed Galax) of Japan both have orbicular leaves.

Order 47. PRIMULALES

178. **Myrsinaceæ** (from the genus *Myrsine*, the Greek name of Myrrh). MYRSINE FAMILY. Trees or shrubs: leaves usually alternate, coriaceous, glandular-dotted: flowers bisexual or unisexual, regular, often very glandular; calyx 4–5-parted, persistent; corolla gamopetalous, rarely of separate petals, 4–5-lobed; stamens 5, opposite the lobes of the corolla, mostly epipetalous, separate or monadelphous; alternating staminodia often present; ovary superior or inferior, 1-celled, placenta basal or free-central; ovules few or numerous; style and stigma 1: fruit a few-seeded berry or drupe.

Widely distributed in the tropics are 32 genera and about 550 species. Two species reach Florida. The family is related to the Primulaceæ, but is woody, glandular, and has indehiscent fruits; also related to the Sapotaceæ.

The leaves of Jacquinia are used in America to stupefy fish; the fruits of this genus are poisonous. The fruits of some species of Ardisia are edible. Bread is made in San Domingo from the crushed seed of *Theophrasta Jussieui*.

About a half-dozen genera are in cultivation in this country, but are little known. Jacquinia and Myrsine are grown in southern Florida and southern California; Ardisia is a genus of greenhouse shrubs. The species ascribed in the trade to Theophrasta on further study have been referred to other genera.

179. **Primulaceæ** (from the genus *Primula*, from Latin *primus* (first), in reference to the early flowering of some European species). PRIMROSE FAMILY. Fig. 47. Herbs: leaves mostly opposite or whorled, often dotted or mealy: flowers bisexual, regular, rarely slightly irregular; calyx not bracteate, mostly 5-parted; corolla

gamopetalous, 5-lobed, rarely of separate petals; stamens 5, epipetalous, opposite the corolla lobes, often alternating with staminodia; ovary superior, rarely half-inferior, 1-celled, many-ovuled; placenta free-central; style and stigma 1: fruit a capsule opening by valves or by a transverse lid.

The family has 28 genera and about 320 species of more or less cosmopolitan distribution, but most abundant in north temperate regions. It is most closely related to the Myrsinaceæ and Plumbaginaceæ. The herbaceous habit, dehiscent fruit, and many seeds are important distinguishing characteristics. The flowers of this family often have styles and stamens of different lengths in the same species (heteromorphic), e. g., Primula. The free-central placentation is characteristic of this and related families.

Rhizomes of Primula were formerly used for diseases of the bladder. Primrose wine is made from the flowers of *Primula officinalis* and *P. vulgaris*. Rhizomes of Cyclamen are purgative and emetic. In some countries these rhizomes are used to stupefy fish; roasted they become good food for pigs (sowbread of Europe). Other species have been used in medicine. Many are ornamental plants.

Twelve to 18 genera are in cultivation in North America. Among these are the following well-known names: Cyclamen; Dodecatheon (Shooting-star); Androsace (Rock Jasmine); Anagallis (Pimpernel, Poor Man's Weather-glass); Hottonia (Featherfoil, Water-Violet, Water-Yarrow) with aquatic inflated stems and fine leaves; Lysimachia (Loosestrife, Moneywort, Creeping Charlie); Primula (Primrose); Soldanella; Stieronema (Loosestrife); Trientalis (Star Flower).

180. **Plumbaginaceæ** (from the genus *Plumbago*, from *plumbum*, lead; perhaps in reference to the lead-like stain given by the roots to the fingers). LEADWORT FAMILY. Fig. 47. Herbs or shrubs: leaves alternate, linear or lanceolate: flowers bisexual, regular; calyx bracteate, 5-fid, usually scarious, and plicate, angled or winged, sometimes colored, persistent; corolla gamopetalous, or of 5 nearly separate petals, mostly convolute; stamens 5, epipetalous, opposite the lobes of the corolla; ovary superior, 1-celled; ovule 1, basal; styles 5: fruit a capsule or utricle, invested by the calyx.

The ten genera and about 250 species, of almost cosmopolitan distribution, are found usually inhabiting seacoasts and alkaline regions; they are most abundant in the Mediterranean region, and in Central Asia. The family is closely related to the Primulaceæ, but has only one seed.

A fatty substance in the root of certain Plumbagos gives a lead-colored stain to the fingers and paper. These roots were formerly used for toothache, ulcers, and the like. Beggars are said still to use them to produce sores. The roots of *Statice latifolia* of Russia contain tannin and have been used for tanning.

There are 5 or 6 genera in cultivation in North America; Acantholimon from Armenia, hardy; Armeria (Sea Pink, Thrift) of Europe and Asia, hardy; Ceratostigma of China, hardy; Plumbago (Leadwort), of Asia, Africa, Australia, mostly of the greenhouse; Statice (Sea Lavender), of Europe, Asia, North America, hardy. Some species of this family are used for dry bouquets.

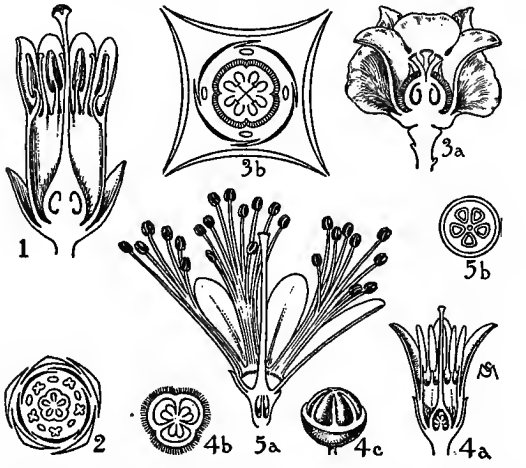
Order 48: EBENALES

181. **Sapotaceæ** (from the old generic name *Sapota*, derived from a native name of *Achras Sapota*). SAPODILLA FAMILY. Fig. 48. Trees or shrubs; juice milky: leaves alternate, entire, coriaceous: flowers usually bisexual, axillary, regular; calyx mostly of separate sepals in two whorls of 2, 3, or 4, or in one whorl of 5; corolla gamopetalous; lobes as many as the sepals, or twice as many, in one or two series, imbricated, sometimes with appendages which simulate extra corolla-lobes; stamens as many as the lobes of the corolla and opposite them, sometimes with intermediate staminodia, or twice as many, epipetalous; ovary superior, 4- to many-celled; ovules 1 in each cell, basal; style and stigma 1: fruit a berry.

There are 31 genera and about 400 species, of tropical distribution, rarely reaching the warm temperate zone. One species extends to Virginia and two to Illinois. This is a distinct family, distantly related to the Myrsinaceæ, Ebenaceæ, and Styracaceæ.

The fruits of *Lucuma mammosa* (marmalade plum), and *Achras Sapota* (sapodilla), are very agreeable. Fruits of Illipe and Mimusops, both Asiatic, are edible. The oil from the seeds of the oriental *Illipe butyracea* and of other species is galam butter, and shea butter. It is used for food and soap. The wood of many species is very hard and valuable—so-called ironwoods. Several species of Palaquium of the East Indies yield gutta percha, as do other species of the family. Gum chicle is obtained from *Achras Sapota*. Star-Apple is *Chrysophyllum Cainito*. West Indian medlar is *Mimusops Elengi*.

Six to 10 genera are in cultivation in North America, mostly in the warmer parts: Mimusops, Lucuma (Marmalade Plum) and Sideroxylon are grown in southern California and Florida; Dichopsis or Palaquium (wrongly called Isonandra), the commercial gutta percha tree, is cultivated in the South. Bumelia and Chrysophyllum are ornamental, the former hardy to Massachusetts.



48. SAPOTACEÆ: 1. Lucuma, flower. 2. Sideroxylon, floral diagram. EBENACEÆ: 3. Diospyros, *a*, female flower; *b*, floral diagram, female flower. STYRACACEÆ: 4. Styrax, *a*, flower; *b*, cross-section ovary; *c*, fruit. SYMPLOCACEÆ: 5. Symplocos, *a*, flower; *b*, cross-section fruit.

182. **Ebenaceæ** (from the Latin *ebenus*, meaning *ebony*). EBONY FAMILY. Fig. 48. Trees or shrubs: leaves alternate, coriaceous, entire: flowers rarely bisexual, usually dicœcious, regular; calyx 3–6-parted, persistent; corolla 3–6-lobed, hypogynous, gamopetalous, urceolate, coriaceous, mostly imbricated and twisted; stamens short, usually double the number of the corolla-lobes, rarely as many or more numerous, hypogynous or epipetalous, separate or united in pairs; ovary superior, 2–16-celled, with 1–2 suspended ovules in each cell; styles and stigmas 2–8: fruit berry-like, rarely subdehiscent.

In this family are 5 genera and about 280 species, of which 180 belong to the genus Diospyros; they are inhabitants of tropical and subtropical regions, principally of the eastern hemisphere. The greatest development of the family is in the East Indies and Malay Archipelago. One species of Diospyros occurs in the eastern United States, from Rhode Island southward. The family is related to the Styracaceæ, Sym-

plocaceæ and Sapotaceæ. The superior several-celled ovary, unisexual flowers and absence of milky juice are important distinctive characters.

The wood of many species, especially of the genus Diospyros, furnishes the ebony of commerce. The fruit of *Diospyros Lotus* is known as date plum in Asia. The fruit of the persimmon (*Diospyros virginiana*) is also edible. The bark of persimmon is sometimes used in medicine.

Three or 4 genera are in cultivation in North America for ornamental purposes. Maba, from Natal, and Royena, from South Africa, are not hardy. Diospyros (Common Persimmon and Kaki), hardy or tender, depending on the species, is grown for ornament or fruit.

183. **Styracaceæ** (from the genus *Styrax*, the ancient Greek name of the storax tree). STORAX FAMILY. Fig. 48. Shrubs or small trees: leaves alternate, simple: flowers bisexual, regular; calyx 4–5-cleft; corolla mostly 4–5-lobed, the lobes almost separate, imbricated or valvate; stamens in one series, hypogynous or epipetalous, twice as many as the lobes of the corolla, rarely just as many, separate or more or less united; ovary superior, rarely half-inferior, 1-celled at the top, 3–5-celled at the bottom; 1, rarely several, ovules in each cell; style 1; stigmas 1–5: fruit a capsular drupe.

Six genera and about 100 species are distributed in the warmer regions of South and Central America, southeastern United States, eastern Asia, and the Mediterranean region. The family is very closely related to the Symplocaceæ; also to the Ebenaceæ and Sapotaceæ. The superior, imperfectly several-celled ovary, bisexual flowers and absence of milky juice are distinctive. Fossil species are known.

Styrax Benzoin of the East Indies yields the fragrant resin known as benzoin. It is a pathological product of the tree. Some Brazilian species of Styrax and some species of Pamphilia also yield a fragrant resin which is burned as incense in the churches. The storax of the ancients was obtained from *Liquidambar orientalis* (family Hamamelidaceæ).

Two or 3 genera are in cultivation in America: Halesia (Silver Bell, Snowdrop Tree), of eastern United States, is hardy; Styrax (Storax) of China, Japan, and America, is semi-hardy. Pterostyrax of Japan is by some referred to Halesia.

184. **Symplocaceæ** (from the genus *Symplocos*, derived from the Greek, meaning *connected*, referring to the stamens). SYMPLOCOS FAMILY. Fig. 48. Trees or shrubs: leaves alternate, simple: flowers bisexual, or less commonly unisexual, regular; calyx 5-lobed, gamosepalous, imbricated; corolla-lobes 5 or 10, in 1 or 2 series, gamopetalous, imbricated; stamens 15 to many in 1–3 or many series, separate, or slightly united with each other and the corolla, hypogynous or epipetalous; ovary inferior or half-inferior, 2–5-celled, with about 2 ovules in each cell; style 1; stigmas 1–5: fruit drupaceous.

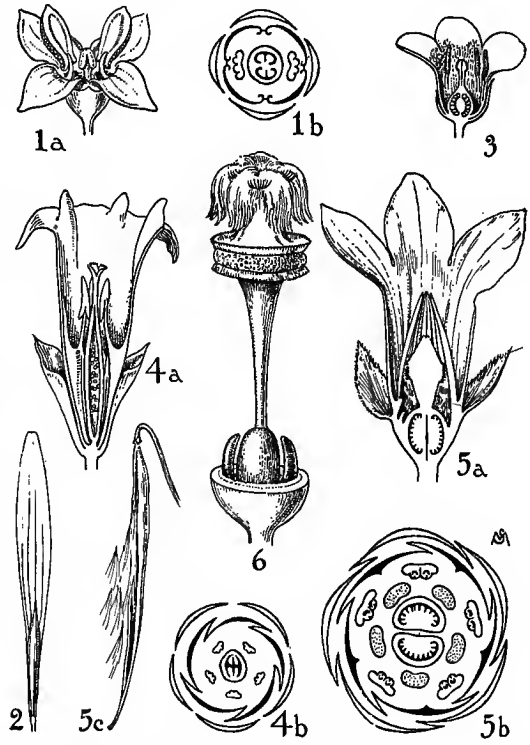
Only one genus and about 275 species are found in tropical lands; they are most abundant in the Malay region and East India. A few species in Japan, and one in North America, extend the family into the temperate zone. *Symplocos tinctoria* reaches Delaware. The family is related to the Styracaceæ, and is often united with it. The inferior, completely several-celled ovary, and numerous stamens, are important characteristics. Fossil species are known.

The bark of *Symplocos racemosa* is used as a medicine in the East Indies under the name lotus bark. The leaves of *S. spicata* and the roots of *S. tinctoria* are used in the preparation of yellow dye-stuffs. *S. cratægoides* is a hardy ornamental shrub from Japan.

Order 49. CONTORTÆ

185. **Oleaceæ** (from the genus *Olea*, derived from the Greek meaning, originally, *olive tree*, and later *oil*, i. e., olive oil). OLIVE FAMILY. Fig. 49. Trees or shrubs: leaves opposite, simple or pinnate: flowers bisexual or unisexual, regular, small and numerous; calyx 4-lobed, rarely 4–15-lobed, valvate; corolla 4-lobed, rarely 6–12-lobed, gamopetalous, rarely polypetalous, or 0, hypogynous, valvate; stamens 2, rarely 3–5, epipetalous, alternate with the corolla-lobes; ovary superior, 2-celled; ovules usually 2 in each cell; style 1 or 0; stigmas 1–2: fruit a drupe, berry, capsule, or samara.

Oleaceæ has 20 genera and more than 400 species, of temperate and tropical lands; these are especially abundant in the East Indies and East Asia. About 10 species are native in northeastern North America. Fossil species are known. The family is related to the Loganiaceæ; possibly also to the Celastraceæ and



49. OLEACEÆ: 1. Olea, *a*, flower; *b*, floral diagram. 2. Fraxinus, fruit. LOGANIACEÆ: 3. Logania, flower. GENTIANACEÆ: 4. Gentiana, *a*, flower; *b*, floral diagram. APOCYNACEÆ: 5. Apocynum, *a*, flower; *b*, floral diagram; *c*, fruit. 6. Vinca, pistil.

Rubiaceæ. The numerical plan of 4, the 2 stamens and the superior ovary are important distinctive characteristics.

The most useful plant is the olive (*Olea europæa*) of the Orient, long cultivated in the Mediterranean region. The oil expressed from the fruit is used as food, and for other purposes. The unripe fruits, preserved in brine, are the olives of commerce. The bark of the fringe tree and privet contains medicinal principles of minor importance, as do also the leaves of the lilac. A saccharine exudation from the bark of *Fraxinus Ornus* of Sicily, induced by the puncture of a cicada, is manna (See, also, *Tamarix mannifera*). The wood of olive and ash are valuable. The flowers of *Osmanthus fragrans* have been used to scent tea in China.

A dozen genera are in cultivation in North America: Chionanthus (Fringe Tree), hardy; Forsythia (Golden Bell), hardy; Fontanesia, hardy; Fraxinus (Ash), hardy; Jasminum (Jasmine, Jessamine), of the greenhouse and the South; Ligustrum (Privet), hardy; Olea (Olive),

not hardy; Osmanthus (Fragrant Olive and Devilwood), not hardy; Phillyrea, not hardy; Schrebera, not hardy; and Syringa (Lilac), hardy.

186. **Loganiaceæ** (from the genus *Logania*, named in honor of J. Logan, a botanist). LOGANIA FAMILY. Fig. 49. Herbs, shrubs, or trees: leaves opposite, simple: flowers usually bisexual, regular; calyx 4–5-lobed or -parted; corolla 4–5-, or 10-lobed, imbricated or convolute; stamens epipetalous, of the same number as the lobes of the corolla and usually alternate with them, rarely reduced to 1; ovary superior, usually 2-celled, rarely 1-or 4-celled; ovules usually numerous; styles 1; stigmas 1–2: fruit a capsule, rarely a berry or drupe.

The family contains 32 genera and about 360 species, of tropical distribution. A few genera only reach the temperate zone, 4 species of which are native in northeastern North America. Fossil species are known. The family is related to the Apocynaceæ, Gentianaceæ, Solanaceæ, Rubiaceæ, and Scrophulariaceæ. The opposite stipulate leaves, and 2-celled superior ovary, are important distinctive characters.

The seeds and bark of *Strychnos nux-vomica* contain a very poisonous alkaloid, strychnine, used as a nerve tonic. Curare, with which the Indians of South America poisoned their arrows, is probably obtained from the bark of *S. toxifer*. Other species of Strychnos are used in Java to poison arrows. The root of Spigelia (pink-root), an American plant, has been used as a vermifuge. It is also poisonous. *Strychnos Ignatia* yields the poisonous ignatius bean of India. The nut of *S. potatorum* is the clearing nut of India, which is used to purify foul water, by rubbing it on the inside of the vessel. The roots of yellow jasmine (*Gelsemium sempervirens*) of the southeastern United States are used as a nerve tonic.

Three or 4 genera are in the North American trade, all ornamental: Buddleia, semi-hardy; Gelsemium (Yellow Jessamine), woody vine, semi-hardy; Spigelia (Pink-Root), herbaceous, hardy.

187. **Gentianaceæ** (from the genus *Gentiana*, named in honor of King Gentius of Illyria, who, according to Pliny, first discovered the medicinal properties of these plants). GENTIAN FAMILY. Fig. 49. Herbs, rarely shrubs or small trees: leaves opposite, rarely alternate or whorled, exstipulate: flowers bisexual, regular; calyx 4–5-parted, persistent; corolla 4–8-lobed, gamopetalous, hypogynous, convolute or induplicate, rarely valvate; stamens of the same number as the corolla-lobes and alternate with them, epipetalous; hypogynous disk usually present; ovary superior, 1-celled, with 2 parietal placentæ, rarely 2-celled; ovules numerous: fruit a capsule.

The 63 genera and about 750 species are almost cosmopolitan in distribution. Three hundred species belong to the genus Gentiana, distributed mostly in the mountains of the north temperate zone, in the arctic zone and in the Andes; they are wanting in Africa. Fossil species of Menyanthes are known. The family is closely related to the Loganiaceæ. The commonly 1-celled ovary, exstipulate leaves and the presence of a bitter principle are important characters.

The general occurrence of a bitter principle renders the majority of Gentianaceæ valuable as tonics, and appetizers. Most of the drug, gentian, is obtained from *Gentiana lutea* of Europe. *G. punctata*, *G. purpurea*, and *G. Pannonica* are also used. *Erythræa Centaurium* (centaury) furnishes a medicinal bitter principle. *Tachia guianensis* is used as bitters in South America, under the name quassia. The bitter principle of Menyanthes is used as a medicine, and also as a substitute for hops in flavoring beer. The Gentianaceæ are used medicinally in all parts of the globe.

Several genera are in cultivation in North America: Erythræa; Eustoma; Frasera; Gentiana (Gentian); Menyanthes (Buckbean); Sabbatia; and Swertia. Nymphoides (Limnanthemum) (Floating Heart, Water Snowflake) is a genus of peculiar aquatic plants. Villarsia is a close relative of Nymphoides.

188. **Apocynaceæ** (from the genus *Apocynum*, the ancient name of the dogbane, from the Greek). DOGBANE FAMILY. Fig. 49. Herbs, shrubs or trees with milky juice, often climbing: leaves opposite or whorled, rarely alternate, entire, exstipulate: flowers bisexual, regular; calyx 4–5-parted; corolla 4–5-lobed, hypogynous, gamopetalous, usually with appendages or folds in the throat, convolute or valvate; stamens 4–5, epipetalous, alternating with the corolla lobes; anthers usually sagittate and acute; pollen granular; hypogynous disk usually present and variously lobed; ovaries usually 2, rarely more or less united; mostly superior, each 1-celled, many-seeded, style 1, usually bearing a fleshy ring below the solitary stigma: fruit follicular with comose seeds, or indehiscent, or berry-like, or of nutlets, sometimes winged or prickly.

One hundred and thirty genera and about 1,000 species occur, mostly in tropical countries in both hemispheres. Five or 6 species reach northeastern North America. The family is related to the Asclepiadaceæ and Gentianaceæ. The milky juice, sagittate anthers, absence of corona, stylar ring, and usually separate ovaries but connate styles and stigmas, are important characteristics.

Many species of Landolphia yield commercial caoutchouc, as do also other genera, such as Urceola and Willoughbya. Some are very poisonous, e. g., Tanghinia of Madagascar; also Cerbera and Acocanthera. Tanghinia, the ordeal tree of Madagascar, "is the most poisonous of plants; a seed no larger than an almond suffices to kill twenty people." Death has followed the use of oleander wood as meat-skewers. An infusion of its leaves is an insecticide; of its bark, a rat-poison. Some are heart-poisons, for example Strophanthus and Aspidosperma (quebracho bark). The bark of Alstonia is a tonic. *Allamanda cathartica* is purgative. Several species furnish edible fruits tasting like citron. *Wrightia tinctoria* furnishes an indigo; *W. tomentosa*, a yellow dye.

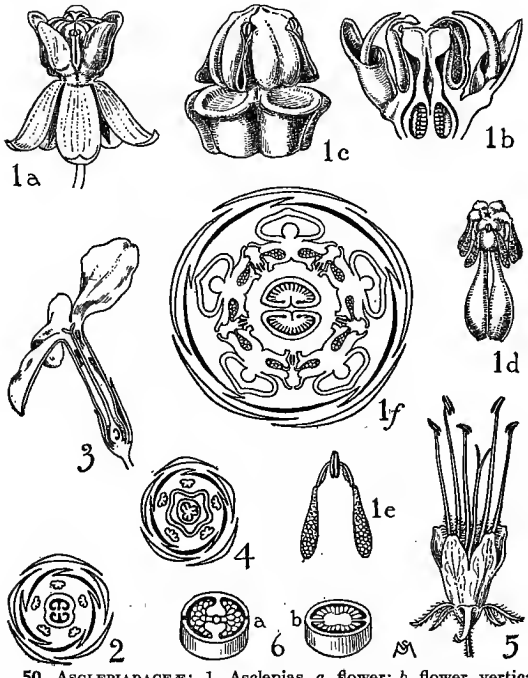
About 20 to 25 genera are in cultivation in N. America as ornamental plants, mostly in the South or in the greenhouse. Among these are: Allamanda; Carissa (Carаunda, Christ's Thorn); Amsonia; Apocynum (Dogbane); Nerium (Oleander); Tabernæmontana (Crape Jasmine, Nero's Crown); Trachelospermum (Star Jasmine); and Vinca (Periwinkle).

189. **Asclepiadaceæ** (from the genus *Asclepias*, dedicated to Æsculapius). MILKWEED FAMILY. Fig. 50. Herbs or shrubs, sometimes fleshy, often climbing, generally with milky juice: leaves opposite, rarely otherwise, exstipulate: flowers bisexual, regular, very frequently in umbels; calyx 5-parted, imbricated; corolla 5-parted or -lobed, gamopetalous, hypogynous; a crown present, which is either an outgrowth of the corolla, or of the stamens, or of both; stamens 5, mostly hypogynous, alternating with the lobes of the corolla, usually monadelphous, sometimes united with the styles; pollen usually agglutinated into pollinia, which are attached to glandular appendages of the stigma; disk absent; ovaries 2, superior, each 1-celled, many-seeded; styles 2; stigmas united: fruit of two follicles; seeds usually comose.

There are 217 genera and about 1,900 species, principally of the tropics, but many reach the temperate zone. The family is distinct, and closely related only to the Apocynaceæ. The Asclepiadaceæ is one of the most extraordinary of families. Most species have a milky juice. Many in South Africa are fleshy, cactus-like plants. Some are epiphytes with variously modified foliage. One genus of epiphytes bears foliar pitchers that catch and hold rain-water. Some species are like a bundle of leafless whip-lashes; others have remarkable tuberous bases to store water. The floral crown is most diverse; and the details of insect-pollination, especially the behavior of the pollinia, is very compli-

cated. The union of the two carpels by the stigma only is unique.

Pleurisy root (*Asclepias tuberosa*) was formerly used extensively for lung and catarrhal disorders. Condurango, from the bark of *Marsdenia Condurango*, is a stomach tonic. The milky juice of many is medicinal; some are emetics (Vincetoxicum, Gomphocarpus, Secamone); others are purgative (Solenostemma,



50. ASCLEPIADACEÆ: 1. Asclepias, *a*, flower; *b*, flower, vertical section; *c*, stamens; *d*, pistil and pollinia; *e*, pollinia and gland; *f*, floral diagram. CONVOLVULACEÆ: 2. Convolvulus, floral diagram. POLEMONIACEÆ: 3. Phlox, flower. 4. Polemonium, floral diagram. HYDROPHYLLACEÆ: 5. Hydrophyllum, flower. 6. Phacelia, *a*, and *b*, ovary of two species.

Cynanchum); others are sudorifics (Hemidesmus). The acrid juice of Gonolobus is used to poison arrows; that of Periploca to poison wolves, hence the name wolfbane and dogbane. The milk of *Gymnema lactiferum*, the cow-plant of Ceylon, is edible; also that of the Cape, *Oxystelma esculentum*. Some Indian species yield good bast fibers. *Marsdenia tinctoria* yields a dye. Several species yield caoutchouc. The oschur or modar (*Calotropis procera*) is probably the sodom apple of the Bible. The herbage of several species is cooked and eaten. The acid stem of Sarcostemma is eaten as a salad. In East Africa, *Cynanchum sarcostemmoides* is used to poison fish. Many Asclepiadaceæ are ornamental plants.

About 20 genera are in cultivation in N. America, mostly in the tropical horticulture of Florida and California. More generally cultivated and better known are: Asclepias (Milkweed); Cynanchum (Mosquito Plant, Cruel Plant); Hoya (Wax-plant); and Periploca (Silk Vine).

Order 50. TUBIFLORÆ

190. **Convolvulaceæ** (from the genus *Convolvulus*, signifying to *entwine*). MORNING-GLORY FAMILY. Fig. 50. Herbs, shrubs or small trees, twining or erect, turf-forming shrubs, thorny shrubs, "switch plants," or yellow, leafless, twining parasites, often with milky juice: leaves alternate: flowers bisexual, regular; peduncles very often bi-bracteate; calyx 5-parted, persistent; corolla more or less 5-lobed, usually plaited, gamopetalous, hypogynous, convolute; stamens 5, slightly epipetalous, alternating with the corolla-lobes; hypogynous disk present, usually lobed; ovary superior, 2-celled, rarely more or fewer celled; each cell 1–2-ovuled, micropyle directed downward and outward; styles 1–2; stigmas 1–2: fruit a capsule or a berry, very rarely breaking into 4 1-seeded nutlets.

Convolvulaceæ has 40 genera with about 1,000 species, of which 300 species belong to the genus Ipomœa and 160 species to the genus Convolvulus. They are distributed in all regions except the arctics; but are especially numerous in tropical Asia and tropical America. The family is related to the Solanaceæ and Boraginaceæ, but also to the Polemoniaceæ and Hydrophyllaceæ. The absence of a circinate inflorescence, the plaited corolla, the direction in which the micropyle is turned and the few-seeded fruit are important distinguishing characteristics. The genus Cuscuta is parasitic and chlorophylless, receiving its nutriment by means of haustoria from the plant upon which it twines.

Because of the substances contained in the milky juice, many species are medicinal. The following are purges: jalap (*Exogonium Purga*), of Mexico; turbith (*Operculina Turpethum*), of the East Indies; and scammony (*Convolvulus Scammonia*), of the orient. The fleshy roots of *Ipomœa Batatas* (sweet potato) are edible; also those of *Convolvulus Sepium*. *Ipomœa Pes-capræ* is used in India to bind the sands along the coast. *Convolvulus scoparius* of the Canaries furnishes the fragrant oil of rhodium, used to adulterate oil of rose, and sold also to rat-catchers as a lure for rats. *Cuscuta Epilinum*, and several other species, are bad pests in cultivated fields.

Several genera are in cultivation in N. America: Argyreia, tender twiners; Breweria, trailing, grown in Florida; Convolvulus (Bindweed, California Rose, Rutland Beauty), mostly twining.; Ipomœa (Morning-glory, Moonflower, Cypress Vine, Indian Pink, Man-of-the-Earth, Blue Dawn Flower, Sweet Potato, Jalap), mostly twining; Jacquemontia, garden twiners; Lettsomia, twiners, grown in Florida.

191. **Polemoniaceæ** (from the genus *Polemonium*, an ancient name of doubtful application). POLEMONIUM FAMILY. Fig. 50. Herbs, rarely woody: leaves alternate, or the lower sometimes opposite, simple or pinnate: flowers bisexual, regular, or nearly so; calyx 5-cleft; corolla 5-lobed, gamopetalous, hypogynous, convolute; stamens 5, epipetalous, alternate with the corolla-lobes; hypogynous disk present; ovary superior, 3-, rarely 2- or 5-, celled; ovules in each cell many, rarely 1; style 1, 3-fid, rarely 5-fid; stigmas 3, rarely 5: fruit a capsule.

About 8 genera and 200 species are known; these are almost entirely American and principally North American. Nearly 100 species belong to the genus Gilia. The family is closely related to the Convolvulaceæ, and difficult to separate from that family. The 3 many-ovuled cells of the ovary are important. The disk of Cobæa is large and 5-lobed. The terminal leaflet of this plant is a branched tendril.

Many Polemoniaceæ are grown as ornamental plants. *Polemonium cæruleum* (Jacob's ladder, or Greek valerian) is used in some countries as a remedy for various ailments.

About 6 to 8 genera are cultivated in this country as ornamental plants: Cantua, a shrub in the greenhouse; Cobæa, a climbing herb, mostly in the greenhouse; Gilia, many species, for bedding; Lœselia in the coolhouse; Phlox (Phlox, Ground or Moss Pink), for bedding; Polemonium, for bedding.

192. **Hydrophyllaceæ** (from the genus *Hydrophyllum*, meaning *water-leaf*). WATER-LEAF FAMILY. Fig. 50. Annual or perennial herbs: leaves mostly alternate, often lobed: flowers bisexual, regular, mostly in circinate raceme-like clusters; calyx 5-cleft; corolla 5-lobed, often

with scales in the throat, gamopetalous, hypogynous, imbricated; stamens 5, alternating with the corolla-lobes, slightly epipetalous; hypogynous disk present; ovary superior, 1-celled, rarely incompletely 2-celled; ovules 2 to several; style 1; stigmas 2: fruit a capsule.

The 17 genera and about 170 species are found most abundantly in temperate North America, less commonly southward to Patagonia. A very few are found in south and east Africa, India, Japan, and the Hawaiian Islands. The family is most closely related to the Boraginaceæ, but has a 1-celled ovary; more distantly related to the Convolvulaceæ and Polemoniaceæ.

Eriodictyon glutinosum (yerba santa) of California has lately come into use as an expectorant in throat and lung trouble. *Hydrophyllum canadense* has long had a reputation as a remedy for snake-bites, poison-ivy poisoning, erysipelas, and other skin troubles.

About a half dozen genera are in cultivation in N. Americaas ornamental plants. They are used principally for outdoor bedding. Emmenanthe (California Yellow or Golden Bells); Hesperochiron; Hydrophyllum (Waterleaf); Nemophila; and Phacelia.

193. **Boraginaceæ** (from the genus *Borago*, an ancient name having reference to the roughness of the foliage). Borage Family. Fig. 51. Herbs, rarely shrubs or trees: leaves usually alternate, very frequently rough-hairy: flowers bisexual, regular, rarely irregular; inflorescence usually circinate; calyx 4–5-cleft, persistent; corolla 4–5-lobed, gamopetalous, hypogynous, imbricated, often with scales or folds in the throat; stamens 5, epipetalous, alternating with the corolla-lobes; hypogynous disk usually present; carpels 2; ovary superior, 4-celled, either entire and style terminal, or 2-lobed, or more commonly deeply 4-lobed with the style basal between the lobes; each cell 1-ovuled; style 1; stigmas usually 2: fruit rarely a berry, usually of 4 1-seeded nutlets, with the surface variously smooth, polished, wrinkled, barbed, winged, or crested.

There are 85 genera and about 1,500 species widely distributed in the temperate and tropical zones, most abundant in the Mediterranean region and in western North America. The largest genera are Cordia with 230 species, and Heliotropium with 220 species. The family is most closely related to the Hydrophyllaceæ; also related to the Verbenaceæ and Labiatæ. The circinate inflorescence, and 2-carpelled, 4-celled ovary with 1 seed in each cell, are distinctive characteristics. The fruit of the Boraginaceæ is most diverse, and very important in classification within the family.

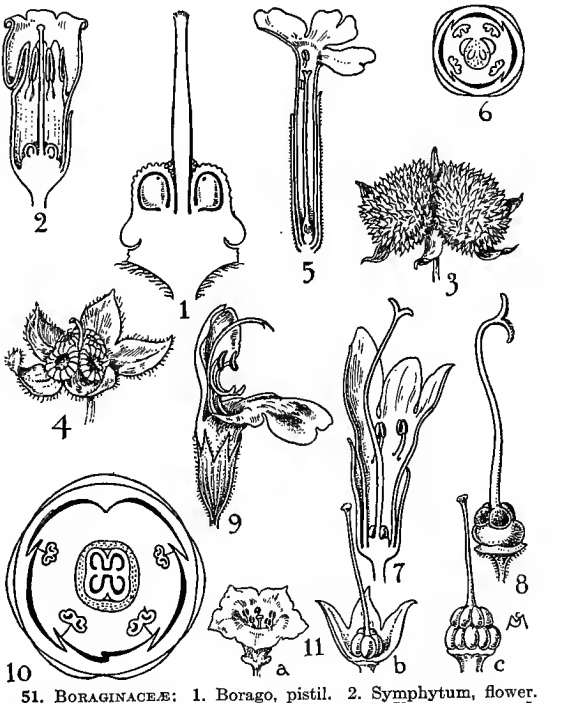
Many species, native in Europe, were formerly used for medicine; for example, comfrey (*Symphytum officinale*), borage (*Borago officinalis*), hound's-tongue (*Cynoglossum officinale*), lungwort (*Pulmonaria officinalis*), viper's bugloss (*Echium vulgare*), bugloss (*Anchusa officinalis*), gromwell (*Lithospermum officinale*), and heliotrope (*Heliotropium europæum*). *Tournefortia umbellata* was used in Mexico as a febrifuge. The roots of alkanet (*Alkanna tinctoria*) of South Europe and Asia contain a red dye of commercial importance. The roots of some species of Anchusa, Onosma, Lithospermum and Arnebia also contain a red pigment. The wood of some species of Cordia is of value, as are also its bast fibers. The wood of several species of Ehretia is valuable, and the fruit is edible.

About 30 genera are in cultivation in N. America, mostly as hardy ornamental border plants. Among these are: Arnebia (Prophet's Flower, Arabian Primrose); Anchusa (Alkanet, not the real); Borago (Borage), used as a pot-herb or bee-plant; Cerinthe (Honeywort); Cynoglossum (Hound's-tongue); Echium (Viper's Bugloss); Lithospermum (Gromwell, Puccoon, Indian Paint); Myosotidium (Giant Forget-me-not); Myosotis (Forget-me-not); Mertensia (Virginian Cowslip, Virginian Lungwort); Omphalodes (Navelwort, Creeping Forget-me-not); Onosma (Golden Drops); Onosmodium (False Gromwell); Pulmonaria (Lungwort, Bethlehem Sage); and Symphytum (Comfrey).

194. **Verbenaceæ** (from the genus *Verbena*, the Latin name for any sacred herb; application obscure). Vervain Family. Fig. 51. Herbs, shrubs, or trees: leaves opposite, rarely whorled or alternate, simple or compound: flowers bisexual, rarely regular, usually oblique or 2-lipped; calyx 4–5-, rarely 6–8-, toothed; corolla 4–5-lobed gamopetalous, hypogynous, lobes imbricated; stamens 4, didynamous, rarely 5 or 2, epipetalous, hypogynous; disk present; ovary superior, of 2, rarely of 4 or 5, carpels, 2–5-celled, but by false partitions 4–10-celled, entire or 2–4-lobed; ovule usually solitary in each cell; style 1; stigma usually 1: fruit a drupe or berry, often separating into drupelets.

Verbenaceæ has 67 genera and about 750 species, mainly of tropical and subtropical distribution. Eleven species reach the northeastern United States. Lippia is the largest genus with 100 species; Clerodendron has 90 species, and Verbena 80 species. The family is closely related to the Labiatæ and not clearly distinct from that family. The predominatingly terminal style, and not deeply lobed ovary are the only differentiating characters.

Many species have been used in medicine: *Verbena hastata* as bitters; species of Lippia as tonics; *Ægiphila salutaris* as a purge and remedy for snake-bites. Species of Clerodendron have very sweet-scented flowers. They



51. Boraginaceæ: 1. Borago, pistil. 2. Symphytum, flower. 3. Cynoglossum, fruit. 4. Omphalodes, fruit. Verbenaceæ: 5. Verbena, flower. 6. Lantana, floral diagram. Labiatæ: 7. Mentha, flower. 8. Thymus, pistil. 9. Salvia, flower. 10. Lamium, floral diagram. Nolanaceæ: 11. Nolana, *a*, flower; *b* and *c*, pistils of different species.

are used as purges, diuretics, and for liver, stomach, and lung complaints. *Lippia citriodora* yields a fragrant substance used in flavoring cream, and other foods. Several species have been used as tea in America. *Duranta Ellisia* and species of Lantana have edible fruit. *Verbena officinalis* of Europe is a tonic, but more famous for its use in witchcraft. It was celebrated among the Romans and Druids of Gaul and used by them in religious ceremonies. The very valuable teak-

wood is obtained from *Tectona grandis* of farther India and the East Indies. The white mangrove trees of Brazil belong to various species of the tribe Avicenniæ.

A score of genera are in cultivation in North America. Among these are: Amsonia, a greenhouse shrub; Callicarpa, greenhouse or hardy shrubs; Caryopteris, a shrub, not hardy; Clerodendron (Turk's Turban), greenhouse or hardy; Duranta (Golden Dewdrop), cultivated in the South; Lantana, greenhouse or bedding herbs or shrubs; Lippia (Lemon Verbena), greenhouse or hardy shrubs or herbs; Petræa (Purple Wreath), greenhouse climber; Verbena, bedding or greenhouse herbs; Vitex (Chaste Tree, Hemp Tree, Monk's Pepper Tree), semi-hardy shrubs or trees.

195. **Labiatæ** (the name refers to the 2-lipped [bilabiate] character of the corolla of most species). MINT FAMILY. Fig. 51. Herbs or shrubs, commonly with a four-angled stem, and usually containing a fragrant oil: leaves opposite or whorled: flowers bisexual, very rarely unisexual, irregular, rarely regular, usually bilabiate; calyx 5-toothed or cleft, regular or 2-lipped; corolla 5-lobed, rarely 4-lobed, gamopetalous and hypogynous, 1 lip sometimes obsolete, the lobes imbricated; stamens 4, didynamous, or only 2, epipetalous; hypogynous disk well developed, thick, entire or lobed; ovary superior, of 2 carpels, deeply 4-lobed, 4-celled, each cell 1-ovuled; style basal or sub-basal; stigmas 2: fruit of 4 1-seeded nutlets; the ectocarp rarely fleshy.

One hundred and fifty-seven genera and about 2,800 species are distributed over the whole earth, but are especially abundant in the Mediterranean region and the orient; they are also abundant in the mountains of the subtropics. The larger genera are Salvia, 500 species; Hyptis, 300 species; Stachys, 180–200 species; Scutellaria, 180 species; Nepeta, 150 species; Satureia, 130 species; and Teucrium, 100 species. The family is related to the Verbenaceæ and to the Boraginaceæ, also to the Scrophulariaceæ and Acanthaceæ. The 4-angled stem, fragrant oil, 4-lobed ovary, the solitary ovules, and the basal style are distinctive. This is a difficult family for the student. The characters for separating the genera reside mostly in the calyx, corolla and stamens. The nutlets are less important in classification than in the Boraginaceæ.

Owing to the volatile oil and bitter principles, the Labiatæ are of more than usual economic importance: *Scutellaria lateriflora* (skullcap), tonic, nervine; *Salvia officinalis* (garden sage), tonic, also used as a condiment; *Marrubium vulgare* (hoarhound), tonic, anthelmintic, and expectorant; *Hedeoma pulegioides* (American pennyroyal), carminative and stimulant; *Mentha spicata* (spearmint) and *Mentha piperita* (peppermint), carminative; *Mentha Pulegium* (European pennyroyal), carminative; mints are also used as condiments. The following oils are from Labiatæ: Oil of thyme (*Thymus Serpyllum*); rosemary (*Rosmarinus officinalis*); Lavender (*Lavandula officinalis*); spike (*Lavandula Spica*); origanum (*Origanum Majorana*). Catnip (*Nepeta Cataria*) is a family sudorific. Mother-wort (*Leonurus Cardiaca*) is a family stimulant and bitters. The leaves of lavender and patchouli (*Pogostemon Patchouli*) are used to keep insects from woolens, furs, and the like. Many other species have been used locally for various purposes.

Fifty or more genera are in cultivation in North America. Most of these are garden annuals or hardy perennials cultivated for the flavor or odor, for ornamental purposes, or for medicine. Among these are: Acanthomintha (Thorny Mint); Ajuga (Bugle Weed); Cedronella (Balm of Gilead); Coleus; Collinsonia (Horsebalm, Horse-weed, Stonewort); Cunila (Maryland Dittany); Hedeoma (American Pennyroyal); Hyssopus (Hyssop), hardy shrub; Lamium (Dead Nettle); Lavandula (Lavender); Leonotis (Lion's Ear, Lion's Tail); Lophanthus (Giant Hyssop); Marrubium (Horehound); Melissa (Balm); Mentha (Mint, Spearmint, Peppermint, Japanese Mint, Bergamot Mint, Black Mint, White Mint, European Pennyroyal); Micromeria (Yerba Buena); Moluccella (Shell Flower, Molucca Balm); Monarda (Horsemint, Oswego Tea, Bee-balm, Fragrant Balm, Wild Bergamot); Nepeta (Catnip, Ground Ivy, Gill-run-over-the-ground); Ocimum (Basil); Origanum (Marjoram); Phlomis (Jerusalem Sage); Physostegia (False Dragonhead, Obedient Plant); Plectranthus (Cockle-spur Flower); Pogostemon (Patchouli Plant); Prunella or Brunella (Self-heal, Heal-all); Pycnanthemum (Mountain Mint); Rosmarinus (Rosemary, Old Man); Salvia (Sage, Clary, Scarlet Sage); Satureia (Savory); Scutellaria (Skull-cap); Stachys (Woundwort, Choro-gi, Chinese or Japanese Artichoke, Knot-root, Betony); Teucrium (Germander); Thymus (Thyme, Mother-of-Thyme); Trichostema (Blue Curls, Bastard Pennyroyal, Ramero); Westringia (Victorian Rosemary).

196. **Nolanaceæ** (from the genus *Nolana*, derived from *nola*, a little bell, in reference to the corolla). NOLANA FAMILY. Fig. 51. Herbs or small shrubs: leaves alternate, or opposite: flowers bisexual, regular; calyx 5-cleft; corolla 5-lobed, gamopetalous, hypogynous, plicate in the bud; stamens 5, slightly epipetalous, alternating with the lobes of the corolla; hypogynous disk well developed, often lobed; ovary superior, typically of 5 carpels, radially lobed, or both radially and transversely lobed, lobes 5–30, in fruit forming 5–30 nutlets which are each 1–7-seeded, or sometimes both radially and transversely lobed.

There occur 3 genera and 50 species, confined to the west coast of South America. Many species are maritime. The family is related to the Convolvulaceæ, also to the Boraginaceæ and Solanaceæ. The plicate corolla and very peculiarly lobed ovary derived from 5 carpels are distinctive.

A few species of Nolana, all prostrate plants, are cultivated in this country for ornamental purposes.

197. **Solanaceæ** (from the genus *Solanum*, the significance unknown). NIGHTSHADE FAMILY. Fig. 52. Herbs, erect or climbing shrubs, or small trees: leaves usually alternate: flowers bisexual, rarely unisexual, regular, rarely irregular; calyx 5-cleft; corolla 5-lobed, gamopetalous, hypogynous, usually plicate in the bud, the folds twisted to right or left, rarely the tips of the folds valvate or imbricated; stamens 5, epipetalous, alternating with the corolla-lobes; hypogynous disk present; ovary superior, 2-celled, rarely falsely 1-, or more, celled; ovules in each cell 1 to many; style 1; stigmas 1–2: fruit a berry or capsule.

About 70 genera and 1,600 species, 900 of which belong to Solanum, are distributed in the tropical and warm temperate regions, the greatest number being in Central and South America. The family is related to the Scrophulariaceæ, Convolvulaceæ and Nolanaceæ. The regular, plaited corolla, and usually numerous seeds are important distinguishing characteristics. Datura has a prickly fruit. The calyx of Physalis is accrescent and inflated, surrounds the fruit, and is often colored.

Many Solanaceæ contain narcotic or poisonous alkaloids and are used in medicine. Belladonna (alkaloid atropine) is obtained from the roots of *Atropa Belladonna;* it was formerly used by women to dilate the pupils of the eye, hence the specific name. The leaves and flowers of *Datura Stramonium* (Jimson weed) constitute the stramonium of medicine (alkaloid daturine). Stramonium seeds were formerly used by magicians to produce fantastic visions, and by thieves to stupefy their victims. Henbane (alkaloid hyoscyamine) consists of the leaves and tops of *Hyoscyamus niger* and is narcotic. Mandragora is similar in effect to belladonna. It was used by sorcerers to produce hallucinations in their victims. *Scopolia carniolica* and *Solanum carolinense* (horse-nettle) have been used in medicine. The remedy, pichi, con-

sists of the dried twigs of *Fabiana imbricata* of Chile. European bittersweet (*S. Dulcamara*) has been used as medicine; it is poisonous. Black nightshade (*S. nigrum*) and others are poisonous. Tobacco is the dried leaves of *Nicotiana Tabacum*. Winter cherry (*Physalis Alkekengii*) is diuretic. Chilli is a name for the fruits of *Capsicum annuum* of South America. Cayenne pepper is the fruit of various species of Capsicum. Tomato, or love apple, is the fruit of *Lycopersicum esculentum* (=*Solanum Lycopersicum*). Species of nightshade, when cooked, are eaten as greens. Eggplant is the fruit of *S. Melongena* of Asia. Potatoes are the tubers of *S. tuberosum* of Peru and Chile.

About 30 genera are cultivated in North America as ornamental plants or for food. Among these are: Atropa (Belladonna); Capsicum (Red or Cayenne Pepper); Cestrum; Cyphomandra (Tree Tomato); Datura (Angel's Trumpet, Datura); Hyoscyamus (Henbane); Lycium (Matrimony Vine, Box Thorn); Lycopersicum (Tomato), [Engler and Prantl unite this with Solanum]; Mandragora (Mandrake of history); Nicotiana (Nicotina, Tobacco); Nicandra (Apple of Peru); Nierembergia (Cup-flower, White Cup); Petunia; Physalis (Ground Cherry, Strawberry Tomato, Alkekengi, Bladder Cherry, Cape Gooseberry, Chinese Lantern Plant); Salpiglossis; Schizanthus (Butterfly Flower, Poor man's Orchid); Streptosolen; Solandra; and Solanum (Nightshade, Potato, Pepino, Melon Pear, Melon Shrub, Eggplant, Guinea Squash, Aubergine, Jerusalem Cherry, Potato Vine, Bittersweet).

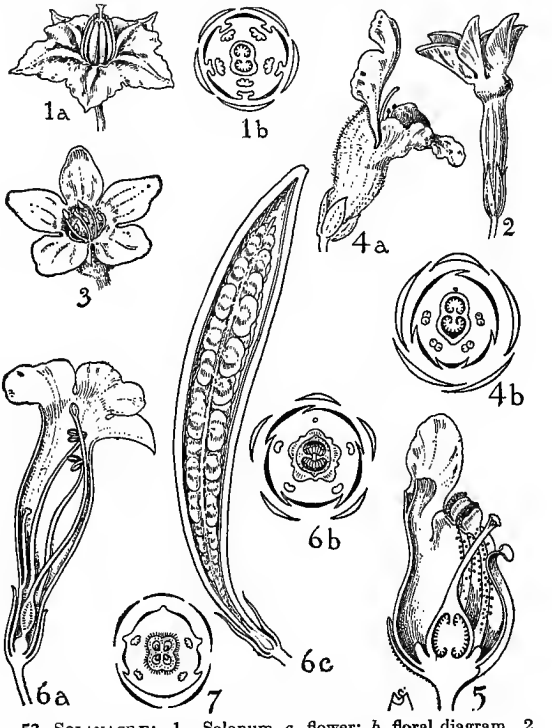
198. **Scrophulariaceæ** (from the genus *Scrophularia*, a reputed remedy for scrofula). FIGWORT FAMILY. Fig. 52. Herbs, shrubs, or small trees: leaves alternate, opposite or whorled: flowers bisexual, regular or commonly irregular, often bilabiate, in which case the throat is often closed by a palate; calyx 5-cleft; corolla 5-lobed, gamopetalous, hypogynous, rarely spurred at the base, imbricated; fertile stamens rarely 5, usually 4 and didynamous, rarely 2; sterile often present as staminodia; epipetalous; hypogynous disk annular or unilateral; ovary superior, 2-celled; ovules many; style 1; stigmas 1–2: fruit generally a capsule, rarely a berry.

Scrophulariaceæ is a family of 179 genera and about 2,500 species, distributed very generally over the whole earth. A few are aquatic and have finely divided leaves. Some are half-parasites on the roots of other plants. A few are total parasites without chlorophyll. The largest genera are Verbascum containing 160 species, Calceolaria with 134 species, Veronica with 200 species, and Pedicularis with 250 species. The family is related to the Solanaceæ, to the Orobanchaceæ and Gesneriaceæ. The non-plicate imbricated usually irregular corolla, reduced number of stamens, and 2-celled, many-ovuled ovary, are distinctive characters.

The economic uses of the Scrophulariaceæ are medicinal and ornamental. *Veronica officinalis* has been used as a tonic and an astringent. *Veronica Beccabunga* has been used for scurvy. *Scrophularia nodosa* was a remedy for fevers. Antirrhinum was used as a diuretic. *Euphrasia officinalis* was used in ophthalmia, and hence the name "eye-bright." *Gratiola officinalis* (poor man's herb) is a violent purgative. *Digitalis purpurea* is the most valuable medicinal plant in the family. It is poisonous, and a well-known diuretic and sedative-narcotic. The tropical *Scoparia dulcis* is a febrifuge. *Veronica virginica* (Culver's root), *Verbascum Thapsus*, *Linaria vulgaris*, and *Chelone glabra* have also been used in medicine. The snapdragon and foxglove are well-known garden plants of this family.

Because of the showy flowers, 30 to 40 genera are in cultivation in N. America for ornamental purposes. Among these are: Antirrhinum (Snapdragon), garden and greenhouse; Calceolaria, greenhouse plants, mostly from South America; Castilleia (Painted Cup), garden plants; Chelone (Turtlehead), hardy garden plants; Collinsia, garden annuals; Digitalis (Foxglove), hardy garden plants; Erinus, hardy; Gerardia, hardy; Gratiola, hardy; Halleria (African Honeysuckle), cultivated in the southern borders; Linaria (Butter-and-Eggs, Kenilworth Ivy, Mother-of-Thousands, Toad-flax), hardy and greenhouse; Mimulus (Monkey Flower, Musk Plant), garden annuals or hardy; Paulownia, semi-hardy tree; Pedicularis (Lousewort, Wood Betony), hardy; Pentstemon (Beard Tongue, Pentstemon), hardy; Phygelius (Cape Fuchsia), mostly greenhouse; Rhodochiton (Purple Bells), vine, garden annual; Russelia, greenhouse; Scrophularia (Figwort), hardy; Tetranema (Mexican Foxglove), greenhouse; Torenia, garden; Verbascum (Mullein), hardy; Veronica (Speedwell, Culver's Root, Fluellen, Ground Hele, Angel's Eyes, Bird's Eyes), garden, mostly hardy or annual.

199. **Bignoniaceæ** (from the genus *Bignonia*, named for the Abbe Jean Paul Bignon, court librarian at Paris,



52. SOLANACEÆ: 1. Solanum, *a*, flower; *b*, floral diagram. 2. Nicotiana, flower. SCROPHULARIACEÆ: 3. Verbascum, flower. 4. Antirrhinum, *a*, flower; *b*, floral diagram. 5. Scrophularia, flower. BIGNONIACEÆ: 6. Campsis, *a*, flower; *b*, floral diagram; *c*, fruit and seeds. PEDALIACEÆ: 7. Sesamum, floral diagram.

and a friend of the botanist Tournefort). BIGNONIA FAMILY. Fig. 52. Woody plants, rarely herbs, usually climbing or twining in the tropical forests: leaves opposite, rarely alternate, usually compound: flowers bisexual, more or less irregular, scarcely bilabiate; calyx 5-cleft, rarely bilabiate or spathe-like, sometimes with appendages; corolla 5-lobed, gamopetalous, hypogynous, imbricated; stamens 4, didynamous, or only 2, the others staminodial, epipetalous; anthers various; hypogynous disk present; ovary superior, 2-celled, rarely 1-celled; many-ovuled; style 1; stigmas 2: fruit a woody capsule; seeds usually winged and very compressed; endosperm 0.

The family contains 100 genera and from 500–600 species, principally natives of the tropics; these are most abundant in America. Three species reach the northeastern United States, from New Jersey and Ohio southward. The largest genus is Tabebuia with

80 species. The family is related to the Scrophulariaceæ; but the peculiar fruit with winged seeds and the absence of endosperm are distinctive. The climbing species may or may not have foliar tendrils. These, when present, terminate in adherent disks. The woody, tropical, climbing Bignoniaceæ are famed for the peculiar cambium growth which produces secondary thickening of such a nature as to give to the cross-section very odd and very diverse patterns, some of which are almost geometrical in their regularity. The wood in these patterns may be either divided into four wedges at right angles to each other, or four wedges may be superimposed on a smaller circle of wood, or the wedges may be divided toward the periphery into peculiar finger-like portions, or there may be concentric rings of wood.

Catalpa and Tecoma have been used in medicine but are not officinal. Caraboa (*Jacaranda Copaia*) contains an aromatic resin of the odor of coumarin. Many are ornamental plants with large, handsome flowers.

About 20 genera are in cultivation in North America, all as ornamental plants. Among these are: Bignonia (Trumpet Flower, Cross Vine, Quarter Vine), mostly greenhouse climbers; Catalpa, semi-hardy or hardy trees; Chilopsis (Desert Willow, Flowering Willow, Mimbres) cultivated in the South; Crescentia (Calabash Tree), cultivated South. Others are Campsis (Trumpet Creeper, T. Vine, T. Honeysuckle); Tecoma (Yellow Elder); Pandorea (Wonga-Wonga Vine; Bower Plant of Australia); Tecomaria (Cape Honeysuckle, climbing or erect shrubs or trees, cultivated mostly in the South, only one of which is fully hardy North.

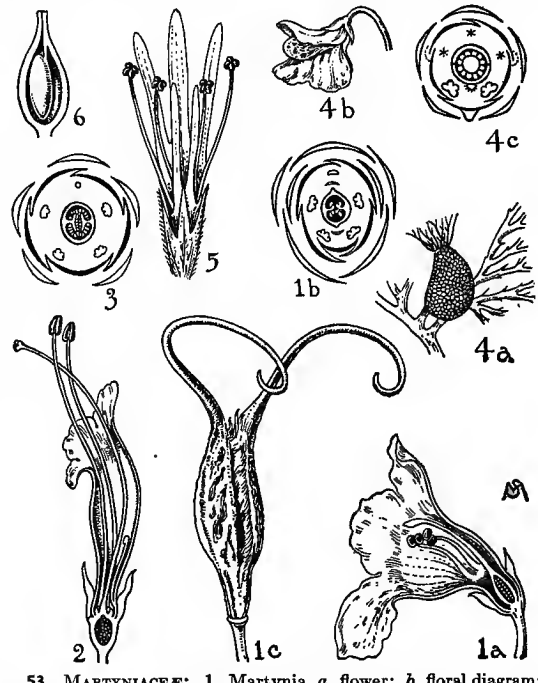
200. **Pedaliaceæ** (from the genus *Pedalium*, signifying a *rudder*, in reference to the winged angles of the fruit). PEDALIUM FAMILY. Fig. 52. Herbs, rarely shrubs, covered with peculiar slime-secreting glands: leaves opposite, or alternate above: flowers bisexual, irregular; calyx 5-cleft; corolla 5-lobed, gamopetalous, more or less curved but indistinctly if at all 2-lipped; stamens 4, didynamous, often with an extra staminodium, subepipetalous; hypogynous disk inequilateral; ovary superior or rarely inferior, 2–4-celled or falsely 1-celled; style 1; stigmas 2–4: fruit a capsule, or a hard indehiscent structure which is often covered with stiff or hooked spines or wings; seeds 1 to several, attached to central placentæ.

In this family are 14 genera and about 50 species, of tropical and subtropical regions of Africa, Arabia, farther India, Ceylon, Australia, and East Indies. They are mostly strand or xerophytic plants. The family is most closely related to the Scrophulariaceæ, and to the Martyniaceæ, with which latter family it is often united. The peculiar slime-glands, the queer fruit, and the axial seeds are important characters.

The seeds of *Sesamum indicum* yield an oil called benne oil or oil of sesame, which is used as food after the manner of olive oil. The oil is also used as a cosmetic and as a medicine. This plant has been cultivated for ages in the orient, and is now cultivated in other lands, the oil being used in the manufacture of soap. *Harpagophytum procumbens* is the famous grapple-plant of South Africa, the fruits of which are difficult to separate from wool and clothing. The fruits of several species of Uncarina are almost as bad. A mucilaginous medicinal drink is made from the leaves of *Pedalium Murex* in India. These leaves are also used to thicken milk, to which they give a rich appearance.

The genera in cultivation in N. America are: Ceratotheca, ornamental greenhouse plants, and grown in Florida, with indistinctly hooked capsules; Sesamum, grown for oil, medicine, or ornament, outdoor annual, capsule not hooked.

201. **Martyniaceæ** (from the genus *Martynia*, in honor of Prof. John Martyn of Cambridge, England). MARTYNIA FAMILY. Fig. 53. Annual or perennial, glandular-hairy herbs: leaves opposite, or alternate: flowers bisexual, irregular, but not bilabiate; calyx 5-cleft; corolla 5-lobed, gamopetalous, hypogynous; stamens 4, didynamous, rarely 2, the others staminodial, epipetalous, alternating with the corolla-lobes; hypogynous disk present, regular; ovary superior, of 2 carpels but



53. MARTYNIACEÆ: 1. Martynia, *a*, flower; *b*, floral diagram; *c*, fruit. GESNERIACEÆ: 2. Gesneria, flower. 3. Achimenes, floral diagram. LENTIBULARIACEÆ: 4. Utricularia, *a*, part of leaf with bladder; *b*, flower; *c*, flower diagram. GLOBULARIACEÆ: 5. Globularia, flower. 6. Cockburnia, vertical section ovary.

1-celled; placentæ parietal; ovules several; style 1; stigmas 2: fruit a more or less long, curved, beaked capsule, with a fleshy pericarp, becoming falsely 4-celled.

About 3 genera and 10 species inhabit tropical and subtropical America. One species reaches southern Indiana. The family is closely related to the Pedaliaceæ, with which it has generally been united. The horned fruit, 1-celled ovary, parietal placentæ and less slimy pubescence, are distinctive characters.

The turnip-like root of *Craniolaria annua*, known in South America as escorzonera, is cooked with sugar or eaten as a vegetable. The fruits of *Martynia* (or *Proboscidea*) *louisiana* (*M. proboscidea*) are sometimes used as pickles.

One genus is in cultivation in this country, namely Martynia (Unicorn Plant, Proboscis Flower), of which 3 or 4 species are grown. The Craniolarias of the trade seem to be Martynias.

202. **Gesneriaceæ** (from the genus *Gesneria*, named after the early botanist Conrad Gesner of Zurich). GESNERIA FAMILY. Fig. 53. Herbs, rarely shrubs or small trees, sometimes climbing: leaves usually opposite or whorled, simple: flowers bisexual, irregular, often bilabiate; calyx 5-parted; corolla 5-lobed, gamopetalous, hypogynous, often gibbous below, imbricated; stamens rarely 5, usually 4 and didynamous, rarely 2, the sterile usually present as staminodia, epipetalous; hypogynous disk present, diverse; ovary superior or inferior, of 2 carpels but 1-celled with 2 parietal placentæ, often falsely 2–4-celled; ovules numerous; style 1; stigmas 1–2: fruit fleshy with pulpy placentæ, or capsular, or silique-like with twisted valves.

Eighty-four genera and about 500 species are widely distributed in the tropics and subtropics of both hemispheres. The largest genera are Cyrtandra containing 180 species and Rœttlera with about 100 species. The family is related to the Scrophulariaceæ, Orobanchaceæ and Bignoniaceæ. The 1-celled ovary without winged seeds, and the non-parasitic habit are distinctive.

The only economic plants in the family are the ornamental, of which there are many. The flowers throughout the family are uncommonly large and showy.

Twenty or more genera are in cultivation in N. America. Among these are the following, all of greenhouse culture: Agalmyla, climbers; Episcia; Gesneria; Isoloma (Kohleria); Nægelia (Smithiantha); Saintpaulia (Usambara Violet; African Violet); Sinningia, including the Gloxinias; Streptocarpus (Cape Primrose); Trichosporum (or Æschynanthus), trailing or drooping.

203. **Lentibulariaceæ** (from the old generic name *Lentibularia*, said to mean *lens*, + *a small pipe*, significance obscure). BLADDERWORT FAMILY. Fig. 53. Aquatic or marsh herbs, or epiphytes: leaves alternate, rarely whorled, very diverse; sometimes finely dissected, or peltate, or oval, or lanceolate; sometimes of two very distinct kinds; usually with very small scattered bladder-like lobes consisting of a complicated trap-like mechanism for catching tiny swimming organisms, or with the whole upper surface of the undivided leaf very glutinous so that insects stick fast to it; either all basal or all cauline, or both: flowers bisexual, irregular; calyx 2–5-cleft, persistent; corolla 5-lobed, more or less 2-lipped and with a spur or sack at the base; upper lip 2-lobed; lower 3-lobed, often with a palate in the throat; stamens 2, epipetalous; ovary superior, of 2 carpels but 1-celled; placenta free-central; style 1; stigmas 2: fruit a capsule.

Belonging to this family are 5 genera and about 300 species, of which at least 200 belong to Utricularia; they are distributed in all parts of the globe but are more numerous in the tropics. One fossil species is known. The family is related to the Scrophulariaceæ. The irregular corolla, 2 stamens, and 1-celled ovary with central placenta, are important characters. This is a most interesting family of insectivorous plants; with the exception of Pinguicula, they are adapted to catch organisms that swim in the water of ponds, or, in case of the epiphytes, in the rain-water in the cracks and crevices of the host plant.

Utricularias were formerly used locally as medicine. The secretion of the leaves of Pinguicula contains a pepsin-like digestive ferment. The Lapps use these leaves to curdle the reindeer milk, hence the common name, butterwort. Danish peasant girls are said to use the juice as a hair-pomade. Another account says, "Pinguicula leaves, whether fresh or dry, are used by the Lapps to thicken fresh still-warm milk, which neither curdles nor gives cream thereafter, but forms a delicious compact tenacious mass, a small portion of which will act similarly on another quantity of fresh milk."

Two genera are in cultivation in N. America for their peculiar habit and curious orchid-like flowers, which are often very showy: Pinguicula (Butterwort); and Utricularia (Bladderwort), mostly epiphytic.

204. **Globulariaceæ** (from the genus *Globularia*, so named because the flowers are borne in heads). GLOBULARIA FAMILY. Fig. 53. Shrubs or herbs: leaves alternate, simple: flowers bisexual, bilabiate, borne in involucrate heads on a chaffy receptacle; calyx mostly 5-parted, bilabiate or regular; corolla 5-lobed, gamopetalous, hypogynous, upper lip sometimes obsolete; the lobes imbricated; stamens 4, didynamous, epipetalous; anthers exserted, by constriction often falsely 4-celled; hypogynous disk usually reduced to a gland on one side; ovary superior, 1-celled; ovule solitary; style 1; stigmas 1–2: fruit a nutlet inclosed in the persistent calyx.

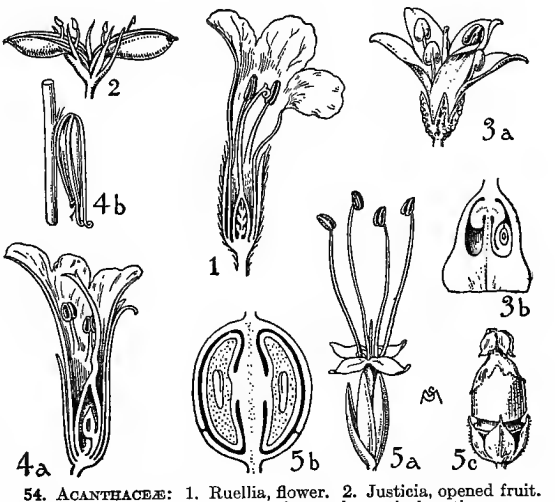
The 3 genera and 20 species are confined to the Mediterranean region. Seventeen species belong to the genus Globularia. The family is related to the Scrophulariaceæ, but is distinguished by the solitary ovule and 1-celled ovary. Globularias are easily mistaken for Scabiosas, because of the involucrate heads and exserted stamens.

Some species are locally used as remedies.

A few species of Globularia are in cultivation in this country; two are hardy, and a third is a greenhouse plant.

205. **Acanthaceæ** (from the genus *Acanthus*, derived from the Greek, *a spine*; some of the plants are spiny). ACANTHUS FAMILY. Fig. 54. Herbs, or rarely shrubs or trees: leaves opposite, rarely whorled: flowers bisexual, irregular, usually bilabiate; calyx 5-cleft; corolla 5-lobed, gamopetalous, hypogynous, the lobes imbricated; stamens usually 4, didynamous, rarely 2, sometimes a staminodium present, epipetalous; hypogynous disk present, mostly small; ovary superior, 2-celled, each cell 2–4-, rarely many-, ovuled; style 1; stigmas 1–2, one lobe often small or wanting: fruit a capsule; seeds exalbuminous, aided in distribution by peculiar outgrowths of the funiculus.

Acanthaceæ has 173 genera and about 1,500 species, of tropical distribution. Few species extend into the Mediterranean region and into the United States. Six species are found in the northeastern United States. Two hundred species belong to the genus Ruellia, and 250 to Justicia. The family is related to the Bignoniaceæ, and to the Scrophulariaceæ, as well as to the other



54. ACANTHACEÆ: 1. Ruellia, flower. 2. Justicia, opened fruit. MYOPORACEÆ: 3. Myoporum, *a*, flower; *b*, vertical section ovary. PHRYMACEÆ: 4. Phryma, *a*, flower; *b*, fruiting calyx. PLANTAGINACEÆ: 5. Plantago, *a*, flower; *b*, vertical section ovary; *c*, fruit.

families of this group. The 2-celled ovary with 2–4 ovules and the queer outgrowths of the funiculus are distinctive.

Many species are used in the tropics for medicine; for example, *Asteracantha longifolia*, a purge and sudorific; *Justicia Gendarussa*, astringent, used in India for rheumatism, and the leaves sprinkled in clothing to keep insects away; *Justicia pectoralis*, used for lung troubles. The young flowers of *Blepharis edulis* and *Asystasia gangetica* are eaten as vegetables. *Ruellia ciliosa* of the United States has recently been sold spuriously as Spigelia (pink root).

Twenty to 30 genera are in cultivation in N. America, except in a few cases, as ornamental greenhouse plants. Among these are: Acanthus (Bear's Breech), hardy

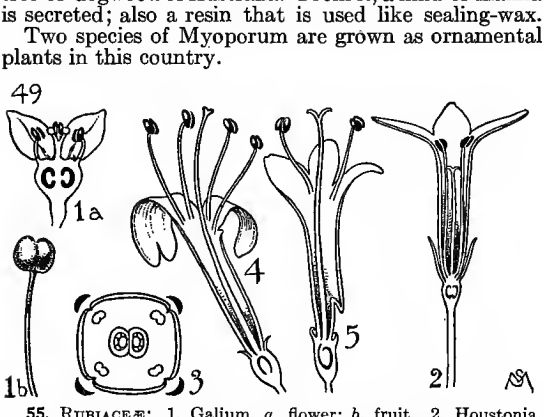
herbs; Adhatoda, shrubs; Aphelandra, shrubs; Crossandra, shrub; Fittonia, herbs; Graptophyllum (Caricature Plant), shrubs; Jacobinia, herbs; Justicia, referred to other genera; Peristrophe; Ruellia, herbs or shrubs; Strobilanthes, often used also for bedding.

206. **Myoporaceæ** (from the genus *Myoporum*, signifying to *shut a pore*, in reference to the spots in the leaves which are closed by a membrane). MYOPORUM FAMILY. Fig. 54. Shrubs or trees: leaves alternate, rarely opposite, usually glandular or woolly: flowers bisexual, regular or irregular; calyx 5-cleft, persistent; corolla 5-lobed, gamopetalous, hypogynous; stamens 4, didynamous, the fifth a staminodium, epipetalous; ovary superior, 2-celled or falsely 3–10-celled; usually 1–2, rarely 8, ovules in each cell; style 1; stigmas 1–2: fruit drupaceous.

There are 5 genera and about 90 species, of which 57 belong to Pholidia and 25 to Myoporum. They are mainly natives of Australia, but scattered species occur in the West Indies, Japan, China, Hawaiian Islands, and elsewhere. The family is related to the Scrophulariaceæ and to the Verbenaceæ. The few ovules, the presence of oil-glands and the pendulous seeds are distinctive.

Myoporum platycarpum is the sandal-tree or sugar-tree or dogwood of Australia. From it, a kind of manna is secreted; also a resin that is used like sealing-wax.

Two species of Myoporum are grown as ornamental plants in this country.



55. RUBIACEÆ: 1. Galium, *a*, flower; *b*, fruit. 2. Houstonia, flower. 3. Bouvardia, floral diagram. CAPRIFOLIACEÆ: 4. Lonicera, flower. VALERIANACEÆ: 5. Valeriana, flower.

207. **Phrymaceæ** (from the genus *Phryma*, a name of unknown derivation). LOPSEED FAMILY. Fig. 54. Perennial herbs: leaves opposite, simple: flowers bisexual, bilabiate; calyx 5-cleft, 2-lipped; corolla 5-lobed, 2-lipped, gamopetalous, hypogynous; stamens 4, didynamous, included, epipetalous; ovary superior, 1-celled; ovule 1, sub-basal, straight (orthotropous); style 1; stigmas 2: fruit dry, indehiscent, inclosed in the abruptly reflexed calyx, the teeth of which are hooked.

A single genus and species occurs in the eastern United States and East Asia. The family is related to the Verbenaceæ and was formerly united with that family; but the peculiar, 1-seeded fruit, with a straight orthotropous seed is distinctive.

Phryma Leptostachya (lopseed) has been in the trade as an ornamental garden plant.

Order 51. PLANTAGINALES

208. **Plantaginaceæ** (from the genus *Plantago*, the Latin name of the plant). PLANTAIN FAMILY. Fig. 54. Annual or perennial herbs: leaves alternate or opposite: flowers bisexual, or rarely unisexual, regular; calyx 4-cleft; corolla 4-lobed, gamopetalous, hypogynous, scarious, imbricated; stamens 4, epipetalous or hypogynous, exserted, alternate with the corolla-lobes; ovary superior, 1–2-celled, rarely 4-celled; ovules 1 to many in each cell; style and stigma 1: fruit a circumscissile capsule, or an indehiscent nutlet, invested by the persistent calyx; seeds usually peltate.

Three genera and about 200 species, of which all but 3 belong to the genus Plantago, are distributed over the whole earth. The centers of distribution are the Mediterranean region and the Andes. This is a very distinct gamopetalous family of doubtful relationship, possibly allied to the Labiatæ.

Many European species were formerly used in medicine; the seeds as mucilaginous emollients in inflammatory ophthalmia, and the like; the leaves as bitters. The seeds are used in India to stiffen muslins. *Plantago lanceolata*, *P. Coronopus* and *P. major* are eaten as greens. The seeds of several species are sold for feeding birds. *P. lanceolata* is used for early pasturage.

The family is not cultivated in N. America, except possibly for bird-seed, pasturage, or pond-border planting.

Order 52. RUBIALES

209. **Rubiaceæ** (from the genus *Rubia*, signifying *red*, from the color of the roots of some species). MADDER FAMILY. Fig. 55. Trees, shrubs or herbs: leaves opposite or whorled, simple, usually entire: flowers bisexual, rarely unisexual, regular, rarely slightly irregular; calyx 2–6-cleft, or 0; corolla gamopetalous, 4–6-lobed, mostly valvate; stamens 4–6, epipetalous; ovary inferior, 1 to many-, commonly 2-, celled; ovules 1 to many in each cell; style 1; stigma 1, capitate or several-branched: fruit a capsule, berry, or drupe.

Rubiaceæ is a family of 343 genera and about 4,500 species, mainly tropical; about 34 species reach the northeastern United States. The family is closely related to the Caprifoliaceæ, but usually has stipules or whorled leaves; it is also related to the Cornaceæ, Valerianeæ, Compositæ, and the like.

A number of tropical Rubiaceæ are myrmecophilous, i. e., provide a dwelling-place for protective ants. The whorled leaves of some species have probably been developed from stipules.

This is an important economic family. *Coffea arabica* (Abyssinia coffee) is generally cultivated in the tropics and used elsewhere as a beverage. *Cinchona Ledgeriana* and *C. succirubra* of the Andes furnish quinine. *Uragoga* (*Caphælis*) *Ipecacuanha* of Brazil is the source of the emetic ipecac. Cephalanthus of North America, and several species of Galium have been used in medicine. *Rubia tinctoria* (Mediterranean) furnishes the red dye, madder. Roots of Asperula and some species of Galium yield red dyes. *Morinda citrifolia* (tropics) yields a yellow dye, morindin. *Ourouparia Gambir* (Malay) yields the dye known as catecu, gambir, or terra japonica. The foliage of *Asperula odorata* has the fragrance of sweet grass, and is used for a similar purpose, and for flavoring wines. *Galium triflorum* has a similar odor. *Galium verum*, the yellow bedstraw (Europe) contains a milk-curdling ferment, hence the name, "galium;" also formerly given to women to increase lactation. Berries of Mitchella contain a saponin-like substance. The fruits of *Vangueria edulis* and several other species of Rubiaceæ are edible. The wood of many species is valuable.

Forty to 50 genera and a great many species are in cultivation in N. America, mostly in the greenhouse and in tropical horticulture. Among these are Indian Mulberry (Morinda); Cape Jasmine (Gardenia); Bluets (Houstonia); Manettia Vine (Manettia); Madder (Rubia); Buttonbush (Cephalanthus, hardy); Bedstraw or Cleavers (Galium); Coffee (Coffea); Cinchona (Cinchona); and Partridge Berry (Mitchella).

210. **Caprifoliaceæ** (from the old genus *Caprifolium*, meaning a *goat-leaf*, possibly in reference to the climbing habit). HONEYSUCKLE FAMILY. Fig. 55. Shrubs, very rarely herbs: leaves opposite, simple or pinnate: flowers bisexual, regular or irregular; calyx 4–5-toothed,

or 4–5-fid; corolla gamopetalous, 4–5-lobed, tubular or rotate; stamens of the same number as the corolla-lobes and alternate with them, epipetalous; ovary inferior, 1–5-celled; each cell 1 to many-ovuled; style 1 or obsolete; stigmas 1–5: fruit a berry or capsule.

The 11 genera and about 350 species are distributed principally in the north temperate zone. The tropical species are mostly confined to the mountains. A few species of Sambucus and Viburnum occur in the southern hemisphere. The family is very closely related to the Rubiaceæ but the leaves are exstipulate; also to the Cornaceæ and Valerianaceæ. Some fossil species have been found.

Many species of Honeysuckle exhale a sweet odor after sunset. The berries of *Lonicera Caprifolium* are said to be diuretic; those of *L. Xylosteum* are laxative. The berries of the European elder (*Sambucus nigra*), and of the American elder (*S. canadensis*) are cooked and eaten and are also made into wine. The dried flowers of elder were formerly used in cases of fever. The roots of the North American *Triosteum perfoliatum* furnish a kind of ipecac. Other species are locally used in medicine. Many are ornamental.

Eight or 10 genera are in cultivation in N. America: Viburnum (Sheepberry, Hobble-bush, Wayfaring Tree, Arrowwood, High Cranberry, Snowball Bush); Sambucus (Elder); Triosteum (Feverwort, Horse Gentian, Wild Ipecac); Symphoricarpos (Snowberry, Coral Berry); Abelia; Diervilla (Weigela, Bush Honeysuckle); Linnæa (Twin-flower); Lonicera (Bush and Climbing Honeysuckles, Woodbine, Trumpet Honeysuckle).

211. **Valerianaceæ** (from the genus *Valeriana*, a word of uncertain origin). VALERIAN FAMILY. Fig. 55. Annual or perennial herbs, often strongly scented: leaves basal and cauline, the latter opposite, simple or pinnate: flowers bisexual or unisexual, regular or irregular, epigynous; calyx of 1–3 minute, but often accrescent, sepals; corolla 5-, rarely 3–4-, lobed, gamopetalous, often produced into a spur at the base; lobes imbricated; stamens 1–4, rarely 5, epipetalous, exserted; ovary inferior, 3-celled, only 1 cell maturing; seed 1; style 1; stigmas 3: fruit dry, indehiscent, 1-seeded.

Eight genera and about 280 species are known, mostly in the north temperate regions of the Old World, especially in the region just north of the Mediterranean, and in South America, where the genus Valeriana is mostly distributed. The family is related to the Dipsacaceæ and the Caprifoliaceæ, and more remotely to the Compositæ. The epigynous, gamopetalous flower, separate stamens, 3 carpels and 1-seeded fruit are distinctive.

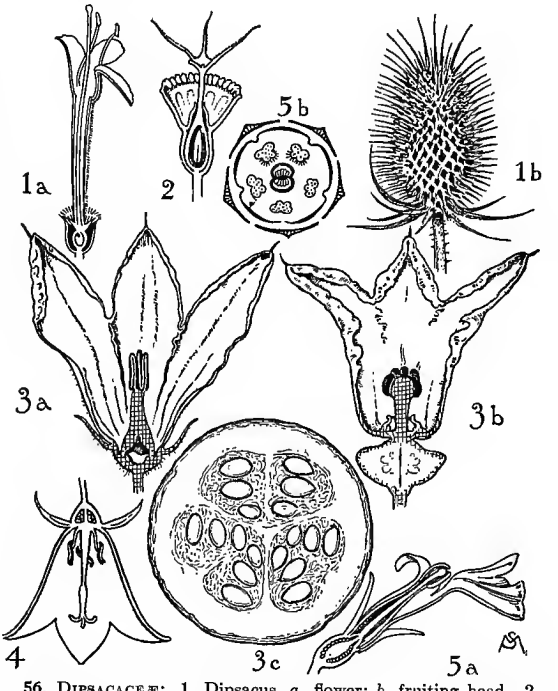
Valeriana officinalis is a powerful nerve sedative with a peculiar odor. Many other Valerianaceæ are used as local remedies for the same purpose. The foliage of various species of Valerianella (lamb's lettuce, corn salad) is eaten as a salad, less commonly as a pot-herb.

In this country few genera are in cultivation: Patrinia as a pot-herb; Centranthus (Red Valerian, Jupiter's Beard) and Valeriana (Valerian) as ornamental plants; and Valerianella (Corn Salad, Fetticus) for food.

212. **Dipsacaceæ** (from the genus *Dipsacus*, derived from the Greek *to thirst*, in allusion to the water-holding leaf-bases). TEASEL FAMILY. Fig. 56. Annual or perennial herbs: leaves opposite, rarely whorled: flowers small, bisexual, mostly irregular, epigynous, in dense involucrate heads; each flower also surrounded by a cup-shaped, more or less scarious, involucre, which is a metamorphosed bracteole; calyx of setaceous segments or crown-like, or plumose, or various; corolla 4–5-lobed, gamopetalous, usually irregular; lobes imbricated; stamens 4, rarely 2–3, mostly epipetalous; ovary inferior, 1-celled, 1-ovuled; style 1; stigmas 2: fruit an achene.

The family has 10 genera and about 150 species, all natives of warm-temperate regions of the Old World, and mostly of the eastern Mediterranean region. The family is related to the Valerianaceæ, and more distantly to the Compositæ. The gamopetalous corolla, 2 carpels, involucrate heads and involucrate flowers are distinctive.

Dipsacus and Scabiosa have been used in medicine. The spiny hooked bracts of *Dipsacus ferox* (fuller's teasel of southwestern Asia) have been used to full cloth, whence the common name; and the plant was once cultivated extensively for this purpose. The connate leaf-bases of *Dipsacus sylvestris* hold several ounces of rain-water until evaporated. This contrivance



56. DIPSACACEÆ: 1. Dipsacus, *a*, flower; *b*, fruiting head. 2. Scabiosa, fruit. CUCURBITACEÆ: 3. Cucurbita, *a*, male flower; *b*, female flower; *c*, cross-section fruit. CAMPANULACEÆ; 4. Campanula, flower. 5. Lobelia, *a*, flower; *b*, floral diagram.

may be of benefit in preventing the ascent of harmful insects.

Four genera are in cultivation in North America: Cephalaria, Morina, and Scabiosa as ornamental plants; *Dipsacus ferox* (*D. fullonum*), locally cultivated in New York state for fulling cloth.

Order 53. CAMPANULALES

213. **Cucurbitaceæ** (from the genus *Cucurbita*, the classical name for the gourd). GOURD FAMILY. Fig. 56. Herbs, rarely shrubs, climbing, usually with branched tendrils: leaves alternate, more or less rounded; veins palmate: flowers usually unisexual, perigynous, regular; stamens 5, rarely separate, usually connate in 2 pairs and 1 free stamen (thus apparently, stamens 3), or monadelphous, inserted at the summit of the ovary; anthers 2-celled, the cells often queerly curved and contorted; carpels usually 3, rarely more or fewer; ovary inferior, mostly 3-celled, many-ovuled: fruit a dry berry with thick rind and spongy center (Pepo), or juicy with hard rind, very exceptionally dehiscent.

There are 87 genera and about 650 species, widely distributed over the earth but most abundant in the tropics; they are wanting in the cold regions. Several are wild in the eastern United States. The family is related to the Campanulaceæ, possibly also to the Passi-

floraceæ. The tendrils are usually borne singly at the nodes and are thought to be modified axillary branches. The fruits are exceedingly diverse and odd. Some are the largest fruits of the vegetable kingdom, others are very tiny. The gourds are very diverse in shape and color,—club-shaped, globular, or flattened from above, or curiously curved.

The family is of considerable economic importance. The fruits of many are edible; e. g., *Cucurbita Pepo* (pumpkin, summer crookneck squash), *C. maxima* (squash), *C. moschata* (winter crookneck squash), *Cucumis Melo* (muskmelon and other melons), *C. sativa* (cucumber), *Citrullus vulgaris* (watermelon). The gourds are cultivated as curiosities and for the fruit to be used as household utensils, e. g., bottle-gourds and calabash (Lagenaria). The leaves, stems, or roots of very many species contain bitter, subresinous substances which render them drastic purgatives. The roots of *Bryonia alba* (bryony) of Europe are highly purgative. The fruits of colocinth (*Citrullus Colocynthis*) of the orient and North Africa furnish a purgative known to the ancients. The fruit of Luffa of India and Arabia is purgative when ripe but edible when green. The outer portion of the fruit of Luffa is very fibrous and reticulated, and, when cleaned, serves as a sponge or dish-cloth in the Antilles (luffa-sponge or Egyptian bath-sponge). The small gourd of *Benincasa hispida* (wax gourd or Chinese watermelon) of tropical Asia is considered an emblem of fertility in India and is presented to newly married couples. Acanthosicyos of the South African desert is remarkably erect and spiny, but the small fruit is considered a delicacy. Elaterium is a drug obtained from the juice of *Ecballium Elaterium*.

The most remarkable fruit is the squirting cucumber (*Ecballium Elaterium*) of the Mediterranean region. The prickly fruit, about 2 inches long, becomes very turgid and finally explodes with a considerable report. The basal end is blown out like a cork from a bottle, and the pulpy interior, containing the seeds, is projected to a considerable distance.

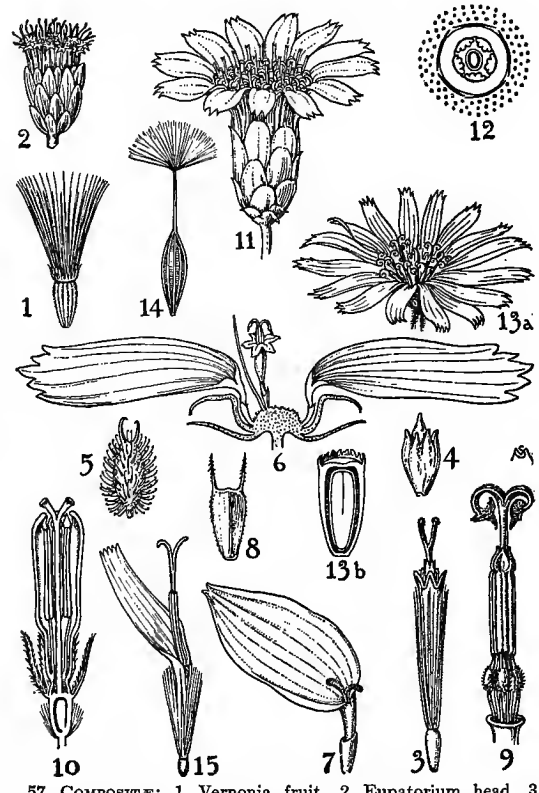
Twenty to 30 genera are in cultivation in N. America. Among these are the various melons, squashes, gourds, and the like, mentioned above; also Bryony, Wax Gourd, Balsam Pear or Balsam Apple (Momordica), Dish-cloth Gourd, Squirting Cucumber, Curuba (Sicana), and Snake Gourd (Trichosanthes).

214. **Campanulaceæ** (from the genus *Campanula*, a diminutive of *campana*, a little bell). Bellflower Family. Fig. 56. Herbs, shrubs, or trees, mostly with milky juice: leaves usually alternate, exstipulate, rarely lobed or divided: flowers bisexual, rarely unisexual, regular or irregular, often bilabiate and split down the back, usually epigynous; calyx of usually 5, separate, valvate sepals; corolla usually 5-lobed, gamopetalous, very rarely polypetalous; stamens as many as the lobes of the corolla, often slightly epipetalous, separate or united; ovary usually inferior, 2–5-celled or 6–10-celled, rarely 1-celled; ovules many; style 1; stigmas 1 to several: fruit a capsule, rarely a berry.

Campanulaceæ has 59 genera and about 1,500 species, occurring in all parts of the world but mostly in the temperate regions. A large part are alpine. Arborescent forms occur in the Hawaiian Islands. The family is rather distantly related to the Compositæ, Dipsacaceæ, Caprifoliaceæ. Formerly the Lobeliaceæ were separated as a distinct family, but the only differences are in the irregular flowers and syngenesious or monadelphous stamens, both of which show abundant transitions. When united, the family constitutes a very distinct group. The gamopetalous epigynous flower, the many ovules and the frequently united stamens are distinctive. The stamens are sometimes united by their filaments with the anthers free (monadelphous), or by the anthers with the filaments free (syngenesious), or by both filaments and anthers.

Lobelia inflata (lobelia, Indian tobacco) of North America is poisonous. The foliage furnishes the medicinal lobelia. *L. syphilitica* was used for syphilis by the Indians, but is of no value. The roots of this latter plant and of the cardinal flower (*L. cardinalis*) are more or less poisonous. The berries and fleshy roots of some Campanulaceæ have been used as food.

In cultivation in N. America are some 20 genera. Among these are: Shepherd's Scabious, or Sheep's-bit (Jasione); Chinese or Japanese Bellflower or Balloon Flower (Platycodon); Venus's Looking-glass (Specularia); Horned Rampion (Phyteuma); Giant Bellflower (Ostrowskia); Lobelia and the Cardinal Flower (Lobelia); and the Bellflowers or Bluebells (Campanula).



57. Compositæ: 1. Vernonia, fruit. 2. Eupatorium, head. 3. Erigeron, disk flower. 4. Ambrosia, fruiting involucre. 5. Xanthium, fruiting involucre. 6. Coreopsis, head. 7. Dahlia, ray flower. 8. Bidens, fruit. 9. Cosmos, disk flower, corolla removed. 10. Helenium, disk flower, vertical section. 11. Mutisia, head. 12. Senecio, floral digaram. 13. Cichorium, *a*, head; *b*, fruit. 14. Lactuca, fruit. 15. Hieracium, ray flower.

215. **Compositæ** (name having reference to the aggregation of the flowers into heads or false flowers, i. e., composite flowers). Composite Family. Fig. 57. Herbs, shrubs, or rarely trees, sometimes twining, often with milky juice: leaves alternate, opposite or whorled, very diverse in shape, size and texture: flowers bisexual or unisexual, regular or irregular, epigynous; subtended by a bract called chaff; aggregated into 1- to many-flowered involucrate heads; calyx (pappus) reduced to hairs, scales, awns, or a border, or wanting; corolla gamopetalous, normally regular, 4–5-lobed; the lobes valvate; in one tribe bilabiate; often enlarged and split down one side, and flattened out (ligulate or ray flowers); stamens usually 4–5, epipetalous, syngenesious, alternating with the corolla lobes; carpels 2; ovary 1-celled, 1-ovuled, inferior; style 1; stigmas 2, rarely 1: fruit an achene, often crowned by the persistent pappus; seed exalbuminous.

This is the largest family of flowering plants, consisting of more than 800 genera and 10,000 to 12,000 species, distributed over all parts of the earth, each tribe usually having a definite center of distribution. The largest genera are: Senecio, 1,200 species; Centaurea, 470; Vernonia, 450; Hieracium, 400; Helichrysum, 300; Baccharis, 275; Cousinia, 210; Artemisia, 200; Crepis, 170; Erigeron, 150; Chrysanthemum, 140; Saussurea, 125; Gnaphalium, 120; Circium, 120; Scorzonera, 100; Anthemis, 100. The Compositæ, taken in the broad sense, is a well-defined family not closely related to any other large families. Its affinities are with the Campanulaceæ, Dipsacaceæ, and Valerianaceæ. In general, the involucrate heads, epigynous gamopetalous flowers, syngenesious stamens, 1-seeded dry fruits and exalbuminous seeds are distinctive. In some genera the heads have no ray flowers (discoid), in others they have a marginal row, and in still others all the flowers are ligulate. Except in the last case, the ray flowers are without stamens, and frequently without a pistil (neutral). The style-branches are very diverse, and are important in the characterization of tribes. They are often provided with sweeping hairs which push the pollen from the introrse anthers up out of the anther tube as the style elongates. The anthers are caudate in two tribes, and in some genera the filaments contract abruptly when stimulated by touch. In Ambrosia and Xanthium, the anthers are separate, and the bracts of the 1–2-flowered pistillate involucre are fused, woody, indehiscent, and covered with spines or hooks.

The family is divided by Hoffman into 13 tribes, several of which are by some authors considered separate families.

Sub-family I. Disk flowers not ligulate; no milky sap. Consists of twelve tribes, separated on a basis of style-branches, anther-tails, chaff on the receptacle, and so on, as follows: Ironweed Tribe, Boneset T., Aster T., Elecampane T., Sunflower T., Sneezeweed T., Chamomile T., Senecio T., Pot Marigold T., Arctotis T., Thistle T., Mutisia T.

Sub-family II. All flowers ligulate; juice milky. One tribe,—the Dandelion or Lettuce Tribe.

Medicinal Plants: The Compositæ are rich in ethereal oils, fatty oils, resins and bitter principles, and therefore many species are used in medicine. Among others of less importance, the following may be noted: *Artemisia Absinthium* (wormwood), tonic, febrifuge, anthelmintic; *A. Cina* which furnishes santonica from which santonin is extracted, anthelmintic, stimulant; *A. vulgaris* (mugwort) has been used as an emmenagogue and for epilepsy; *Anthemis nobilis* (Roman chamomile), tonic, nervine, emmenagogue; *Matricaria Chamomilla* (German chamomile), with similar properties; *Tanacetum vulgare* (tansy), tonic, anthelmintic, emmenagogue, diuretic; *Arnica montana* (arnica, leopard's bane), skin stimulant, diuretic; *Inula Helenium* (elecampane), skin stimulant; *Eupatorium perfoliatum* (boneset, thoroughwort), tonic, diaphoretic, laxative; many Eupatoriums of the tropics, famed remedies for snake-bites; *Tussilago Farfara* (coltsfoot), sedative; *Arctium Lappa* and *A. minus* (burdock), diaphoretic, alterative, used for rheumatism; *Calendula officinalis* (marigold), diaphoretic, alterative; *Lactuca sativa* (lettuce), the thickened juice a narcotic, a substitute for opium; *L. virosa* (wild lettuce), furnishing lactucarium or lettuce opium, a poisonous anodyne, hypnotic, and sedative; *Taraxacum officinale* (dandelion), tonic, but injurious to digestion; species of Grindelia, tonic, sedative, used for asthma and rheumatism; *Erigeron canadense* (fleabane), used for diarrhea and uterine hemorrhage; *Anacyclus Pyrethrum* (pellitory), skin irritant; *Achillea Millefolium* (yarrow), an old remedy, styptic, tonic, sudorific, antispasmodic. Brauneria (Echinacea), Prenanthes, Xanthium, Helenium, Spilanthes, Baccharis, and *Chrysanthemum Leucanthemum* have been used locally to some extent. The pollen of ragweed (*Ambrosia artemisifolia*), less commonly of species of Solidago and other Compositæ, is said to be the cause of autumnal hay-fever.

The following are used for food, as salads or cooked in various ways: Young foliage of Circium (thistles), *Cynara Cardunculus* (cardoon), *Taraxacum officinale* (dandelion), *Cichorium Intybus* (chicory), *Lactuca sativa* (lettuce), *Cichorium Endivia* (endive, succory), *Pacourina edulis*, and *Scolymus hispanicus*, (Spanish oyster plant); young flower heads of *Cynara Scolymus* (globe artichoke); roots of *Tragopogon porrifolius* (vegetable oyster, salsify), *Scorzonera hispanica* (Scorzonera, black salsify), *Helianthus tuberosus* (Jerusalem artichoke). Roots of chicory, roasted, are a substitute for coffee.

The following yield dyes: *Carthamus tinctorius*, (safflower) yields the red dye, carthamine; *Serratula tinctoria* (dyer's savory) yields a yellow dye.

The powdered heads of species of Chrysanthemum furnish insect powder. An oil is obtained from the seeds of *Guizotia abyssinica* (niger seeds) of India and Abyssinia, used for food, painting, and burning. Seeds of *Madia sativa* furnish an oil similar to olive oil, edible, illuminating, and lubricating. The seeds of *Helianthus annuus* also furnish a commercial oil.

Many Compositæ are ornamental. The species of Helichrysum, Anaphalis, and related genera, have papery involucres, and furnish well-known everlastings.

More than one hundred and fifty genera are in cultivation in N. America, or are important weeds. Many of our most important and most showy ornamental plants belong to the Compositæ. Among these genera are: Achillea (Milfoil, Yarrow, Sneezewort); Ageratum; Anaphalis (Everlasting, Moonshine); Antennaria (Everlasting, Cat's-ear, Pussy's Toes, Ladies' Tobacco); Anthemis (Chamomile, Mayweed, Golden Marguerite); Arctium (Burdock); Arnica (Mountain Tobacco, Mountain Snuff); Artemisia (Wormwood, Tarragon, Estragon, Southernwood, Roman Wormwood, Old Man and Old Woman, Sage Brush); Aster (Aster, Starwort, Michælmas Daisy); Bidens (Bur Marigold, Beggar's Ticks, Pitchfork Bur); Boltonia (False Chamomile); Brachycome (Swan River Daisy); Brickellia (Tassel Flower); Buphthalmum; Calendula (Marigold); Callistephus (China Aster); Cnicus or Carbenia (Blessed Thistle); Carthamus (Safflower, False Saffron); Centaurea (Centaury, Dusty Miller, Bachelor's Button, Cornflower, Knapweed, Bluebottle, Bluet, Ragged Sailor, Sweet Sultan, Basket Flower, Hardheads); Chænactis; Chrysanthemum (Feverfew, Golden Feather, Turfing Daisy, Marguerite, Paris Daisy, Costmary, Mint Geranium, Giant Daisy, Ox-eye Daisy, Whiteweed); Cichorium (Chicory, Succory); Cineraria; Circium or Cnicus (Common Thistles); Coreopsis (Tickseed, Golden Wave); Cosmos; Cynara (Artichoke, Cardoon); Dahlia; Doronicum (Leopard's-Bane); Echinacea or Brauneria (Purple Coneflower); Echinops (Globe Thistle); Emilia (Tassel Flower); Erigeron (Fleabane, Poor Robin's Plantain); Eupatorium (Boneset, Joe-Pye Weed, Thoroughwort, White Snakeroot); Felicia (Blue Daisy, Blue Marguerite); Gaillardia; Gazania (Peacock Gazania); Grindelia (Gum Plant); Gynura (Velvet Plant); Helenium (Sneezeweed); Helianthus (Sunflower, Indian Potato, Jerusalem Artichoke); Helichrysum; Heliopsis; Helipterum; Hidalgoa (Treasure Vine); Hieracium (Hawkweed, Rattlesnake Weed, Devil's Paint-brush); Inula (Elecampane); Krigia (Dwarf Dandelion); Lactuca (Lettuce); Leontopodium (Edelweiss); Leptosyne; Liatris (Blazing Star, Button Snakeroot); Lonas (African Daisy); Madia (Tarweed); Matricaria; Mikania (Climbing Hempweed, Climbing Boneset); Onopordon (Scotch Thistle); Parthenium (American Feverfew, Prairie Dock); Pentachæta; Petasites (Winter Heliotrope, Sweet Coltsfoot); Piqueria; Podolepis; Polymnia (Leaf-cup); Prenanthes (Rattle

snake Root); Rudbeckia (Black-eyed Susan, Yellow Daisy, Coneflower, Golden Glow); Santolina (Lavender Cotton); Scolymus (Golden Thistle, Spanish Oyster Plant); Scorzonera (Black Salsify); Senecio (Groundsel, Canada Plant, Ragwort, German Ivy, Leopard Plant, Dusty Miller); Silphium (Rosin-Weed, Compass Plant, Prairie Dock, Cup Plant); Solidago (Goldenrod); Spilanthes (Para Cress); Stokesia (Stoke's Aster); Tagetes (French Marigold, African Marigold); Tanacetum (Tansy); Taraxacum (Dandelion); Thelysperma; Townsendia; Tragopogon (Salsify, Goat's Beard, Vegetable Oyster, Oyster Plant); Trilisa (Vanilla Plant); Tussilago (Coltsfoot); Verbesina (Crownbeard); Vernonia (Ironweed); Zinnia (Zinnia, Youth-and-Old-Age).

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IV. Upland vegetation.—Trees on a wind-swept plateau.

KEY TO THE FAMILIES AND GENERA

In one of the editions of the Cyclopedia of American Horticulture, a key to the families and genera contained therein was placed in the introductory part to Vol. I. This key is now modified and adapted to the present work. The original key was prepared by Wilhelm Miller, Associate Editor of that Cyclopedia. The main part of Dr. Miller's introduction to that key is here reprinted, with adaptations, as explaining the purpose of a key and the way in which it is constituted.

The key has now been extensively revised, but the original form and method are still retained.

The purposes of the key.

The following key attempts to supply what is probably the greatest deficiency in cyclopedic works on horticulture:

(1) It helps the gardener to determine the name of any plant cultivated in America, including the wild flowers and other plants native to the United States and Canada that are commonly or even frequently offered for sale.

(2) It helps the student towards a scientific knowledge of the plant world, since it gives a condensed and orderly catalogue of that part of the vegetable kingdom which is of interest to gardeners, farmers and foresters.

No merely alphabetical work can accomplish either of these results. For example, suppose the person has a flower that is known to be an Iris, but of what species of Iris is not clear to him; and that he wishes to find the name. If he were to consult the best works in which the species of Iris are arranged alphabetically, it might require hours to read the pages of description, comparing the items with the specimen, and the chances are that in the end he would not be sure of a determination, since related species are not compared and contrasted.

It was to provide a short-cut to such information that every large genus or group of plants described in the Cyclopedia of American Horticulture was classified according to shape, color, size, season, height or other characters of interest to the gardener. These short-cuts, or "keys," have long been in common use with students of botany, and are a feature of all floras, but they have not been sufficiently employed in writings on horticultural subjects.

No valid objection can be made to keys, synopses or other classified arrangements, since they do three things more clearly and briefly than any other device: (1) They help one to find out the name of a plant. (2) They show the difference between the given species and other species of the same genus. (3) They show the relation of each species to every other, i. e., some of the points of likeness and unlikeness.

But classified schemes alone have one serious limitation: They are not so convenient for ready reference if one knows one's plant and merely wishes to find out the native country or how to spell the name. The Cyclopedia of American Horticulture met this need by numbering the species and providing an alphabetical list or index in each large genus. It therefore met the needs by presenting both systems—the classified and the alphabetical—one for taxonomic study, the other for convenience.

All this supposes that one knows the genus to which the plant belongs,—whether it is an Iris, Pæonia or Rhododendron. But he may not know the genus: the key will aid him to determine it. The key leads to the family and the genus; having the genus, he can run down the species in the Cyclopedia itself, for the genera are to be found in alphabetical order. This key, therefore, deals only with families and genera, since the species are described and distinguished elsewhere. It ties the whole work together and makes it an organism, instead of a series of detached articles on Iris, Rosa, Solanum, and other genera. In other words, the key is not merely supplementary: it is structural and even fundamental.

The preparation of the key.

It must be confessed, however, that the preparation of the key was undertaken with serious misgivings. During the preparation of the Cyclopedia of American Horticulture, the Editor was often importuned for something of the kind, by students, botanists, and others who made increasing use of the volumes as issued. In response to these urgent appeals, it was necessary to point out three objections: (1) Such a key would necessarily be highly technical. (2) It would have to use a scheme of arrangement that may pass with another generation. (3) The labor and expense would be great.

In response to this demand the following key has been prepared. It is based on the system of Bentham and Hooker as set forth in their "Genera Plantarum," a work published in parts from 1862 to 1883. The system of Bentham and Hooker is not now the latest, but it is the only one that was in general use at the time the first Cyclopedia was begun. The system of Engler and Prantl in "Die Natürlichen Pflanzenfamilien" is now well known; this no doubt presents the best system for the present generation, but in its turn it is likely to be superseded. In Engler and Prantl's system the plants are arranged, as far as possible, in the order in which the various families probably have made their appearance on the earth's surface, or at all events in accordance with the evolution from simple to complex. Perhaps the new system is better adapted for showing relationship or likeness, while the old system is well adapted for bringing out differences. This furnishes an additional reason for the use of the older system on the present occasion, as most of those who use this part of the Cyclopedia will probably be in search of differences.

In the present revision, the Bentham and Hooker key-plan has been retained. The authors of the main groups in the new Cyclopedia have made revisions and adaptations to meet the changes and requirements of their own work. New conceptions of the limitations of families and genera have naturally found expression in the revision. It is not designed to insert in the key all the genera that are mentioned in a minor or incidental way, for to include them all would unnecessarily encumber and complicate the lists and tend to make them unworkable; but it is intended to include all the genera that afford species prominently in the trade in the United States and Canada. When it has seemed to be desirable to omit genera from the key, the relatively unimportant native groups have often been left out, for they may be readily traced in the current botanies.

The way to use a key is explained in the prefatory part to this volume (page xii).

The general plan.

The key is divided into two main parts: a key to the families (page 80), and a key to the genera (page 86). When the student has determined the family to which the plant belongs, the further tracing of it is to be made in the key to the genera; when the genus has been found, he turns to its alphabetic place in one of the volumes and there runs down the plant to its species.

The families are arranged in accordance with the following framework (for another and fuller outline of the vegetable kingdom, see pages 2–4).

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Subdivision 1. Dicotyledons or Exogens	1–181
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Subclass 1. Polypetalæ	1–101
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Series 3. Calycifloræ	70–101
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Division 2. Pteridophyta	210–223

PART I.—KEY TO THE FAMILIES

(*See page 86 for Part II.*)

Division 1. Flowering Plants or Phanerogams or Spermatophytes: those producing real flowers and seeds (pages 80 to 86).

Subdivision 1. Dicotyledons. Sts. formed of bark; wood and pith, the wood forming a zone between the other two, and increasing when the st. continues from year to year by the annual addition of a new layer to the outside next to the bark: lvs. usually netted-veined: embryo with a pair of opposite cotyledons, or, in Subdivision 2, often 3 or more in a whorl: parts of the fl. mostly in 4's or 5's (pages 80–84).

Class 1. Angiosperms. Pistil consisting of a closed ovary, which contains the ovules: cotyledons 2.

Subclass 1. Polypetalæ. Calyx and corolla both present, the latter of separate petals. (See exceptions listed under Subclass 2, Gamopetalæ, page 82.)

Series 1. Thalamifloræ. Calyx mostly inserted under the ovary; petals often in 2 or more series, sometimes 1 series; stamens ∞ or definite, inserted on the often small or raised or stipitate receptacle, which is not developed into a glandular disk; ovary very generally free.

Cohort 1. Ranales. Stamens ∞, or if definite then the perianth in 3–∞ series; carpels 1 or more, usually distinct, rarely united. (See exceptions in Saxifragaceæ, also hypogynous Leguminosæ.)

A. Sepals 5, or fewer, or 0; petals in about 1 series.
  B. Seeds not arillate: sepals deciduous, usually colored: herbs or shrubs. . . . 1. Ranunculaceæ.
  BB. Seeds not arillate: calyx and corolla wanting; ovary of 2 carpels but 1-celled. . . . 7. Eucommiaceæ.
  BBB. Seeds arillate: sepals persistent, herbaceous: shrubs or trees. . . . 2. Dilleniaceæ.
AA. Sepals or petals in 2–∞ series, rarely wanting.
  B. Plants not aquatic.
    C. Perianth wanting; stamens numerous; fls. polygamous, diœcious, or perfect.
      D. Lvs. pinnately veined, alternate. 5. Trochodendraceæ.
      DD. Lvs. palmately veined, opposite. 6. Cercidiphyllaceæ.
    CC. Perianth present.
      D. Petals and stamens mostly ∞: ovules 1–∞.
        E. Torus tubular, inclosing carpels: endosperm 0: lvs. opposite: shrubs. . . . 3. Calycanthaceæ.
        EE. Torus short or long, bearing carpels outside: endosperm copious: lvs. alternate: woody. . . . 4. Magnoliaceæ.
      DD. Petals 5: stamens 10: carpels 5–10: ovule solitary: lvs. opposite. (See No. 68, Coriariaceæ.)
      DDD. Petals and stamens mostly multiples of 3 or 2.
        E. Stamens and carpels usually numerous: ovules 1–∞: sepals 3; petals 6; fls. bisexual: shrubs or trees. . . . 8. Annonaceæ.
        EE. Stamens usually 6: ovule solitary: carpels 3; sepals and petals usually 6: fls. diœcious: mostly woody or herbaceous vines. . . . 9. Menispermaceæ.
        EEE. Stamens 4, 6, or 9; anthers opening by 2 lids rarely birimose: carpel 1: ovules 2–∞: fls. bisexual: herbs or shrubs. . . . 10. Berberidaceæ.
        EEEE. Stamens usually 6; anthers birimose: carpels mostly 3: ovules many: fls. unisexual: vines or erect, woody. . . . 11. Lardizabalaceæ.
  BB. Plants aquatic. . . . 12. Nymphæaceæ.

Cohort 2. Parietales. Stamens definite or ∞: ovary 1-celled, or several-celled by spurious partitions; carpels several; placentæ parietal. (See Actæa in Ranunculaceæ, also Berberidaceæ.)

A. Embryo minute, near the base of the fleshy endosperm.
  B. Pitcher plants. . . . 13. Sarraceniaceæ.
  BB. Not pitcher plants.
    C. Petals all alike, or nearly so. . . . 14. Papaveraceæ.
    CC. Petals in 2 series, the inner unlike the outer. . . . 15. Fumariaceæ.
AA. Embryo curved; endosperm 0.
  B. Stamens 6, tetradynamous, rarely 4. . . . 16. Cruciferæ.
  BB. Stamens ∞, or, if few, not tetradynamous. . . . 17. Capparidaceæ.
  BBB. Stamens usually ∞, not covered in æstivation by the small petals: ovary often open above. . . . 18. Resedaceæ.
AAA. Embryo not curved, rather large; endosperm fleshy.
  B. Radicle remote from hilum: ovule generally orthotropous. . . . 19. Cistaceæ.
  BB. Radicle very near hilum: ovule anatropous, or amphitropous.
    C. Anthers dehisce introrsely: mostly herbs. . . . 20. Violaceæ.
    CC. Anthers dehisce extrorsely or at apex: insectivorous plants with capitate glandular tentacles on lvs. (See No. 76, Droseraceæ.)
    CCC. Anthers dehisce by apical cracks or pores: woody.
      D. Slime-cells present; receptacle not enlarged. . . . 21. Bixaceæ.
      DD. Slime-cells absent; receptacle enlarged. . . . 22. Flacourtiaceæ.
    CCCC. Anthers versatile, dehiscing by longitudinal fissures: woody. (See No. 34, Stachyuraceæ.)

Cohort 3. POLYGALALES. Stamens as many or twice as many as petals: carpels usually 2: ovary usually perfectly or imperfectly 2-celled, usually compressed.

A. Fls. regular or slightly oblique.
B. Stamens 5, as many as sepals or petals: woody....23. PITTOSPORACEÆ.
BB. Stamens twice as many as sepals or petals, which are usually 4 or 5, rarely 3: woody....24. TREMANDRACEÆ.
AA. Fls. irregular: herbaceous or woody....25. POLYGALACEÆ.

Cohort 4. CARYOPHYLLALES. Stamens definite, rarely ∞; ovary 1-celled or imperfectly septate; placenta central, rarely parietal; embryo curved, or coiled, rarely straight.

A. Sepals of same number as petals: placenta 1, central: herbs....26. CARYOPHYLLACEÆ.
AA. Sepals fewer than petals: placenta 1, central: herbs....27. PORTULACACEÆ.
AAA. Sepals of same number as petals: placentæ several: mostly woody.
B. Corolla polypetalous; stamens without scale, glabrous; fls. spicate or racemose....28. TAMARICACEÆ.
BB. Corolla gamopetalous; stamens with scale, hairy; fls. thyrsoid-paniculate....29. FOUQUIERIACEÆ.

Cohort 5. GUTTIFERALES. Stamens usually ∞: sepals imbricated: ovary septate; placentæ on the inner angles of the cells, i.e., axile. (See also, as exceptions with disk absent, the Linaceæ, Erythroxylaceæ, Malpighiaceæ, Geraniaceæ, Tropæolaceæ, Limnanthaceæ, Oxalidaceæ, Balsaminaceæ, Ochnaceæ, Rutaceæ, Anacardiaceæ and Sapindaceæ, all belonging to the Discifloræ. (See also Nigella of the Ranunculaceæ.)

A. Lvs. opposite or whorled, herbaceous: fls. cymose or panicled, bisexual....30. HYPERICACEÆ.
AA. Lvs. opposite or whorled, coriaceous: fls. cymose or panicled.
B. Receptacle not enlarged; fls. unisexual....31. GUTTIFERÆ.
BB. Receptacle enlarged, barrel-shaped between pistil and corolla, bearing the stamens; fls. bisexual....32. EUCRYPHIACEÆ.
AAA. Lvs. alternate, coriaceous: fls. mostly racemose.
B. Cells of ovary 2–10: stamens numerous....33. TERNSTRŒMIACEÆ.
BB. Cells of ovary 1: stamens 8....34. STACHYURACEÆ.

Cohort 6. MALVALES. Stamens usually ∞ or monadelphous; sepals valvate: ovary septate; placentæ axile.

A. Anthers 1-celled; pollen rough: herbs or woody....35. MALVACEÆ.
AA. Anthers 1- to several-celled: pollen smooth: woody plants....36. BOMBACACEÆ.
AAA. Anthers 2-celled: fls. with staminodia and queer stamen-tube: woody plants....37. STERCULIACEÆ.
AAAA. Anthers 2-celled; stamens nearly free; no staminodia: ovule often pendulous with raphe toward axis.
B. Petals ordinary: herbs or woody....38. TILIACEÆ.
BB. Petals firm, often hairy or incised: woody plants....39. ELÆOCARPACEÆ.

Anomalous Group. Stamens ∞; sepals valvate: carpel 1: ovary 1-celled: fls. regular: lvs. compound: herbs or woody.... (Mimoseæ, incl. in Leguminosæ.)

Series 2. DISCIFLORÆ. Calyx usually inserted under the ovary; petals in 1 series: stamens usually definite, inserted within or upon or around the receptacle, which is usually expanded as a disk within the calyx: ovary usually free, or imbedded in the disk. (See Flacourtiaceæ and Trapaceæ.)

Cohort 1. GERANIALES. Disk usually a ring between stamens, or adnate to staminal tube, or reduced to glands alternating with the petals, rarely 0: ovary commonly lobed, rarely entire or subapocarpous; ovules 1–2 in each cell, pendulous; raphe toward axis. (See Stackhousiaceæ.)

A. Ovary more or less lobed or grooved.
B. Anthers elongated; disk enlarged in fr....51. OCHNACEÆ.
BB. Anthers normal.
C. Calyx-lobes 5, all or mostly with 2 glands outside: woody....42. MALPIGHIACEÆ.
CC. Calyx-lobes not biglandular.
D. Foliage glandular-dotted: carpels sometimes separate....49. RUTACEÆ.
DD. Foliage not glandular-dotted.
E. Lvs. usually opposite, compound....43. ZYGOPHYLLACEÆ.
EE. Lvs. alternate.
F. Disk well developed, irregular; petals often irregular; ovary usually open above: herbs, rarely shrubs. (See No. 18, Resedaceæ.)
FF. Disk well developed, regular: petals regular: ovary closed: woody plants....50. SIMARUBACEÆ.
FFF. Disk indistinct, otherwise as in the last: herbaceous.
G. Ovule solitary: stamens 6–10.
H. Fr. dehiscent: stamens connate at base; fls. regular or irregular....44. GERANIACEÆ.
HH. Fr. indehiscent; stamens free; fls. irregular: ovule pendulous....45. TROPÆOLACEÆ.
HHH. Fr. indehiscent: stamens free: fls. regular: ovule ascending....46. LIMNANTHACEÆ.
GG. Ovules several: fr. dehiscent.
H. Stamens 10: fls. regular....47. OXALIDACEÆ.
HH. Stamens 5: fls. irregular....48. BALSAMINACEÆ.
AA. Ovary entire.
B. Stamens monadelphous, at least below: woody plants.
C. Stamen-tube stipitate; disk various....53. MELIACEÆ.
CC. Stamen-tube sessile; disk 0.
D. Petals not appendaged: fr. capsular....40. LINACEÆ.
DD. Petals appendaged: fr. drupaceous....41. ERYTHROXYLACEÆ.
BB. Stamens free.
C. Ovules several or many.
D. Mostly herbaceous plants. (See No. 17, Capparidaceæ.)
DD. Woody plants. (See No. 22, Flacourtiaceæ.)
CC. Ovules 1–2....52. BURSERACEÆ.

Cohort 2. OLACALES. Disk cup-shaped or ring-shaped, free, or bearing the stamens and petals on its edge: ovary 1–∞-celled, entire; ovule solitary, pendulous; raphe away from axis.

A. Petals or corolla-lobes usually valvate: woody....54. OLACACEÆ.
AA. Petals or corolla-lobes imbricate or convolute.
B. Fr. drupaceous, slightly fleshy, 3–18-stoned; stones 1-seeded: fls. not racemose: woody....55. AQUIFOLIACEÆ.
BB. Fr. crustaceous or spongy, 2–4-celled, 1–4-seeded: fls. racemose: woody....56. CYRILLACEÆ.

Cohort 3. CELASTRALES. Disk tumid or adnate to the calyx or covering its base: stamens inserted around the disk or affixed to its margin: ovary usually entire; ovules usually 2 in each cell, erect: raphe turned toward axis: lvs. simple or rarely compound.

A. Calyx valvate; petals small, concave; stamens opposite the petals: woody....59. RHAMNACEÆ.
AA. Calyx imbricate.
B. Stamens alternate with the petals, the latter imbricate.
C. Petals spreading: calyx small: woody....57. CELASTRACEÆ.
CC. Petals erect, often connate: calyx-tube hemispherical: herbs....58. STACKHOUSIACEÆ
BB. Stamens opposite the petals, the latter valvate, dropping off early: woody, rarely herbaceous....60. VITACEÆ. (Incl. Leeaceæ.)

Cohort 4. SAPINDALES. Disk various; stamens variously inserted on the disk: ovary entire, or more often lobed, or subapocarpous; ovules commonly 1–2 in each cell, ascending, with raphe toward axis, or reversed, or solitary and pendulous from an ascending funicle, rarely ∞ and horizontal: lvs. pinnate, rarely simple (No. 62), or (No. 65) digitate.

A. Carpels 2: fr. a samara....62. ACERACEÆ.
AA. Carpels 2–3: fr. a drupe, 1-seeded....61. SABIACEÆ.
AAA. Carpels 3–5: fr. rarely samaroid in Sapindaceæ.
B. Bark containing resin: disk intrastaminal....67. ANACARDIACEÆ.
BB. Bark not resinous, or, if so, disk extrastaminal.
C. Endosperm abundant; embryo straight.
D. Disk intrastaminal; carpels 3....63. STAPHYLEACEÆ.
DD. Disk extrastaminal; carpels 4–5..64. MELIANTHACEÆ.
CC. Endosperm sparse or wanting; embryo curved: disk extrastaminal. (See Sapindaceæ, No. 66.)
D. Lvs. opposite, palmately compound....65. HIPPOCASTANACEÆ
DD. Lvs. alternate, variously compound, or simple....66. SAPINDACEÆ.

Anomalous Families. Disk 0: sepals and petals 5: stamens 10; carpels 5–10, distinct: ovule solitary, pendulous; raphe away from axis. Approaches Thalamifloræ.....68. CORIARIACEÆ.

Disk investing calyx-tube: stamens 10, of which 5 have no anthers: ovary 1-celled, with 3-parietal placentæ; ovules ∞. Approaches Calycifloræ.....69. MORINGACEÆ.

Series 3. CALYCIFLORÆ. Petals in 1 series: stamens ∞ or definite, inserted with the petals and sepals on the edge of the cup-shaped receptacle (hypanthium), or on a disk lining the latter: ovary often adnate to this receptacle; and therefore inferior. (See also Calycanthaceæ.)

Cohort 1. ROSALES. Carpels superior solitary or free or united only at base, sometimes to the apex and then rarely inferior: styles distinct, rarely united in a column and easily separated (styles connate in some Bruniaceæ and Saxifragaceæ). (See also Tropæolaceæ and Capparidaceæ.)

A. Endosperm rare.
  B. Fr. a legume, when rarely otherwise the corolla is either papilionaceous or the stamens are very numerous and exserted: lvs. usually compound with pulvini.....70. LEGUMINOSEÆ.
  BB. Fr. not a legume, either a follicle, drupe, pome, achene or aggregate: lvs. simple or compound without pulvini.....71. ROSACEÆ.
AA. Endosperm moderate or copious.
  B. Plants insectivorous.
    C. Lvs. bearing many tentacles tipped with capitate viscid glands: herbs.....76. DROSERACEÆ.
    CC. Lvs. bearing pitchers.....74. CEPHALOTACEÆ.
  BB. Plants not insectivorous.
    C. Carpels 5, rarely 3 or more, separate, with a scale at the base of each, superior: ovules many: often fleshy plants: herbs.....75. CRASSULACEÆ.
    CC. Carpels 2 to several, rarely separate, no scale at the base: plants not conspicuously fleshy.
      D. Ovary usually 2-celled, usually superior; ovules ∞, usually axile: fr. a caps. or berry or follicle.
        E. Lvs. opposite, stipulate.....73. CUNONIACEÆ.
        EE. Lvs. alternate, or opposite and exstipulate.....72. SAXIFRAGACEÆ.
      DD. Ovary 2-celled, inferior or rarely superior; ovules 1–∞, pendulous or axile: fr. a woody 2-valved caps., with a separating inner layer of different texture.....77. HAMAMELIDACEÆ.
      DDD. Ovary 1–4-celled, usually inferior; ovules 1 to several, pendulous: fr. indehiscent or cocci irregularly and tardily dehiscent.
        E. Plants heath-like: stamens and petals 5.....78. BRUNIACEÆ.
        EE. Plants ordinary: stamens often many.....79. HALORAGIDACEÆ.

Cohort 2. MYRTALES. Ovary syncarpous, inferior or inclosed in a cup-shaped receptacle, usually divided into cells; style undivided; ovules 2–∞ in the cells.

A. Ovules pendulous from apex of cells: woody.
  B. Ovary 2–6-celled.....80. RHIZOPHORACEÆ.
  BB. Ovary 1-celled.....81. COMBRETACEÆ.
AA. Ovules affixed to the inner angles of the cells or to basilar placentæ, ascending, horizontal or pendulous.
  B. Stamens ∞, rarely definite: woody.
    C. Oil-glands in foliage; sieve-tubes in pith-rays.....82. MYRTACEÆ.
    CC. Oil-glands absent; no sieve-tubes in pith-rays.....83. LECYTHIDACEÆ.
  BB. Stamens definite, rarely ∞.
    C. Calyx-lobes usually imbricate or open; anthers curved, usually opening by pores at the apex; connective usually appendaged or thickened.....84. MELASTOMACEÆ.
    CC. Calyx-lobes usually valvate; anthers normal, not appendaged, opening longitudinally.
      D. Ovary superior; petals corrugated.....85. LYTHRACEÆ.
      DD. Ovary inferior or half-inferior.
        E. Carpels in stories, superimposed: petals corrugated....86. PUNICACEÆ.
        EE. Carpels in 1 whorl: petals convolute.....87. ONAGRACEÆ.
        EEE. Carpels in 1 whorl: petals imbricate; a dentate or wavy cup-shaped disk under ovary: water-plants.....88. TRAPACEÆ.

Cohort 3. PASSIFLORALES. Ovary syncarpous, inferior, semi-inferior, or inclosed in the hollow receptacle, rarely exserted, 1-celled with parietal placentation, or divided into cells; ovules 1–∞; styles united or distinct from the base.

A. Crown inserted on calyx-tube or within petals, single, double or multiple.....90. PASSIFLORACEÆ.
AA. Crown 0.
  B. Fls. bisexual (see Caricaceæ); petals unlike the sepals: foliage-hairs stinging or rigid or queerly constructed.....89. LOASACEÆ.
  BB. Fls. unisexual.
    C. Stamens 5 or 10: perianth of the 2 sexes unlike.....91. CARICACEÆ.
    CC. Stamens usually 3: perianth of both sexes similar.....92. CUCURBITACEÆ.
    CCC. Stamens ∞: perianth of the 2 sexes often unlike.....93. BEGONIACEÆ.

Cohort 4. FICOIDALES. Ovary syncarpous, inferior or superior, divided into cells with sub-basilar placentation, or rarely 1-celled with parietal placentæ; ovules 1–∞; styles distinct or united to near apex; embryo curved or excentric.

A. Calyx-lobes, petals and stamens usually ∞: ovary 1-celled.....94. CACTACEÆ.
AA. Calyx-lobes usually 4–5: ovary 2–∞-celled.....95. AIZOACEÆ.

Cohort 5. UMBELLALES. Ovary syncarpous, inferior, crowned by the disk, divided into cells, or 1-carpelled; styles distinct or united part way; ovules solitary and pendulous in the cells.

A. Fr. separating into 2 dry indehiscent carpels.....96. UMBELLIFERÆ.
AA. Fr. usually drupaceous, the stones distinct but not separating naturally.
  B. Lvs. compound, or simple, and palmately veined.....97. ARALIACEÆ.
  BB. Lvs. simple, pinnately veined.
    C. Ovules 2 in each cell: ovary 1-celled: raphe toward axis: fls. in catkins: lvs. opposite.....98. GARRYACEÆ.
    CC. Ovule 1 in each cell.
      D. Raphe toward axis: ovary 1-celled: fls. in heads: lvs. alternate.....99. NYSSACEÆ.
      DD. Raphe lateral: ovary 1–2-celled; fls. in cymes: lvs. alternate....100. ALANGIACEÆ.
      DDD. Raphe exterior: ovary 1–5-celled: fls. in heads or cymes: lvs. opposite or alternate.....101. CORNACEÆ.

Subclass 2. GAMOPETALÆ. Calyx and corolla both present, the petals usually more or less united: stipules present only in the Rubiaceæ and Loganiaceæ, rarely in the Caprifoliaceæ: corolla polypetalous in some Ericaceæ, in Monotropaceæ, Pyrolaceæ, Clethraceæ, some Styracaceæ and Oleaceæ; also in Galax, Statice, Lysimachia; corolla gamopetalous in some Fouquieriaceæ, Stackhousiaceæ, Leguminosæ, Fumariaceæ, Polygalaceæ, and Oxalidaceæ of the Polypetalæ.

Series 1. INFERÆ. Ovary inferior (see Ericaceæ): stamens as many as lobes of the corolla, rarely fewer.

Cohort 1. RUBIALES. Stamens affixed to the corolla: ovary 2–∞-celled; cells 1–∞-ovuled: lvs. opposite or whorled.

A. Fls. regular or irregular: stipules usually absent.....102. CAPRIFOLIACEÆ.
AA. Fls. regular: stipules present, inter- or intrapetiolar, various in form, sometimes like the lvs. and disposed in the same whorl with them.....103. RUBIACEÆ.

Cohort 2. ASTERALES. Stamens affixed to corolla: ovary of the 2-merous pistil 1-celled, 1-ovuled.

A. Anthers free: lvs. opposite or whorled.
  B. Endosperm 0.....104. VALERIANACEÆ.
  BB. Endosperm present.....105. DIPSACACEÆ.
AA. Anthers united in a ring around the style except in a few genera: lvs. alternate or opposite.....106. COMPOSITÆ.

Cohort 3. CAMPANALES. Stamens usually free from the corolla: ovary 2–6-celled; the cells usually ∞-ovuled: lvs. usually alternate.

107. CAMPANULACEÆ. (Incl. Lobeliaceæ.)

Series 2. HETEROMERÆ. Ovary usually superior: stamens free from the corolla, or opposite the lobes or twice as many, or ∞, or, if borne on the corollan, the alternate with its lobes and equal in number to them; carpels more than 2.

Cohort 1. Ericales. Stamens twice as many as the corolla-lobes, or as many and opposite them: ovary 2-∞-celled; ovules numerous (except in Epacridaceæ): fr. fleshy or berry-like.

A. Anthers dehisce by an apical crack or pore, often produced into a tube; stamens usually 8 or 10 (5 in some Ericaceæ).
B. Chlorophylless plants: polypetalous. 108. Monotropaceæ.
BB. Chlorophyll-bearing plants.
C. Anthers inverted, at least at first; polypetalous.
D. Ovary 3-celled: shrubs. 109. Clethraceæ.
DD. Ovary 5-celled: low or acaulescent plants. 110. Pyrolaceæ.
CC. Anthers erect; rarely polypetalous (Ledum). 111. Ericaceæ.
AA. Anthers dehisce by longitudinal fissures (see also Epigæa); stamens 5.
B. Plants shrubs or trees: carpels 4–5. 112. Epacridaceæ.
BB. Plants low or acaulescent: carpels 3. 113. Diapensiaceæ.

Cohort 2. Primulales. Stamens as many as the corolla-lobes and opposite them; ovary 1-celled; placentæ free-central or basal.

A. Ovary 1-ovuled. 114. Plumbaginaceæ.
AA. Ovary 2 to many-ovuled.
B. Fr. capsular: herbs. 115. Primulaceæ.
BB. Fr. indehiscent: trees or shrubs. 116. Myrsinaceæ.

Cohort 3. Ebenales. Stamens as many as lobes of the corolla and opposite them or twice as many, or ∞; ovary 2-∞-celled; seeds usually few and rather large: woody.

A. Fls. usually bisexual; stamens usually borne on the corolla.
B. Stamens 15–∞: ovary inferior, 2–5-celled. 117. Symplocaceæ.
BB. Stamens 5–10: ovary superior.
C. Ovary 1-celled at top. 118. Styracaceæ.
CC. Ovary 4–∞-celled. 119. Sapotaceæ.
AA. Fls. dicœcious; stamens usually free from corolla. 120. Ebenaceæ.

Series 3. Bicarpellatæ. Ovary usually superior: stamens alternate with corolla-lobes, as many as them or fewer: carpels 2, or rarely 1 or 3.

Cohort 1. Gentianales. Corolla regular: stamens alternate with corolla-lobes and equal to them in number, or, if fewer, usually alternate with carpels: lvs. usually opposite.

A. Stamens 2, alternate with the carpels, rarely 4; stigma terminal; ovary 2-celled; ovules affixed to septum: rarely herbaceous. 121. Oleaceæ.
AA. Stamens and corolla-lobes usually 5, sometimes 4, rarely ∞.
B. Ovary usually compound, with 2 or 3 (rarely 4 or 5) cells or placentæ.
C. Caps. mostly 2-celled: lva. connected by transverse lines or stipulea. 122. Loganiaceæ.
CC. Caps. mostly 1-celled, with parietal placentæ: lvs. not connected as above. 123. Gentianaceæ.
BB. Ovaries 2, usually becoming follicles.
C. Anthers permanently attached to a large stigmatic body; pollen mostly in waxy masses. 124. Asclepiadaceæ.
CC. Anthers distinct or merely connivent; pollen ordinary. 125. Apocynaceæ.

Cohort 2. Polemoniales. Corolla regular: stamens as many as lobes of corolla: lva. usually alternate: ovary 1-∞-ovuled.

A. Pistil 3-merous; corolla-lobes convolute. 126. Polemoniaceæ.
AA. Pistil not 3-merous.
B. Corolla-lobes imbricated or rarely convolute.
C. Style usually deeply 2-cut, or even split into 2 distinct styles: caps. 1-celled, 2-valved, with 2 parietal or introflexed placentæ, or sometimes 2-celled. 127. Hydrophyllaceæ.
CC. Style usually entire or shortly 2-cut, rarely otherwise; ovary 4-ovuled, usually 4-lobed and maturing as 4 separate or separable nutlets; or not lobed, 3–4-celled, and separating when ripe into 2 or 4 nutlets. 128. Boraginaceæ.
BB. Corolla-limb more or less plicate or rarely imbricate.
C. Ovary 2-celled (sometimes 3- or spuriously 4-celled, becoming a globular 4–6-seeded caps.: seeds basal. 129. Convolvulaceæ.
CC. Ovary 2-celled (rarely 3–5-celled), with numerous ovules on expanded axillary placentæ, becoming a pod or berry. 130. Solanaceæ.
CCC. Ovary 5–30-celled, 5–30-lobed, often transversely as well as longitudinally so. 131. Nolanaceæ.

Cohort 3. Personales. Corolla usually irregular or oblique: posterior stamen differing from the others, abortive or even absent: carpels ∞-ovuled, or with 2 ovules, one above the other.

A. Seeds usually with endosperm: ovary perfectly 2-celled; placentæ central. 132. Scrophulariaceæ.
AA. Seeds without endosperm.
B. Plants insectivorous, often aquatic: ovary 1-celled, globose, with a free-central or basal placenta. 133. Lentibulariaceæ.
BB. Plants not insectivorous; not aquatic.
C. Seeds winged: ovary 2-, rarely 1-, celled: trees or climbing shrubs. 134. Bignoniaceæ.
CC. Seeds not winged.
D. Ovary 1-celled or falsely 2–4-celled.
E. Fr. straight or spiral. 135. Gesneriaceæ.
EE. Fr. falcate-rostrate. 136. Martyniaceæ.
DD. Ovary 2–4-celled.
E. Plant very mucilaginous: no hooks among seeds: fr. often hooked or spiny. 137. Pedaliaceæ.
EE. Plants not conspicuously mucilaginous: hooks in caps. aiding in seed-dissemination. 138. Acanthaceæ.

Cohort 4. Lamiales. Corolla usually irregular or oblique: posterior stamen smaller than the others, usually abortive or quite deficient: carpels with 2 ovules placed side by side, or else 1-ovuled

A. Fr. not divided into 4 nutlets: ovary not 4-lobed.
B. Ovary 1-celled, 1-ovuled.
C. Fls. in heads: plant often heath-like. 139. Globulariaceæ.
CC. Fls. in slender interrupted spikes. 140. Phrymaceæ.
BB. Ovary 2–10-celled.
C. Cells with 2–10 ovules: trees or shrubs. 141. Myoporaceæ.
CC. Cells with 1 ovule: herbs or shrubs. 142. Verbenaceæ.
AA. Fr. divided into 4 nutlets: ovary 4-lobed. 143. Labiatæ.

Anomalous Family. Remarkable for its scarious 4-lobed corolla: stamens few; ovary 1-4-celled: fr. a circumscissile caps., or rarely indehiscent; seeds peltate. 144. Plantaginaceæ.

Subclass 3. Apetalæ or Monochlamydeæ. Corolla wanting or undifferentiated from the calyx (except in some Euphorbiaceæ and one genus of Phytolaccaceæ), and sometimes also the calyx wanting; perianth simple, the lobes or segms. in 1 or 2 series, similar among themselves and usually calyx-like, sometimes minute or wanting. (See also Ranunculaceæ, Flacourtiaceæ, Menispermaceæ, Trochodendraceæ, Rosaceæ, Lythraceæ, Onagraceæ, Hamamelidaceæ, Rutaceæ, Aceraceæ, Rhamnaceæ, Euonymiaceæ, Cornaceæ, and Caryophyllaceæ with corolla sometimes absent.)

Series 1. Curvembryeæ. Embryo curved, excentric, lateral or peripheral, rarely straightish, subcentral and narrow (Polygonaceæ); ovule solitary in the ovary or in each carpel or in the Amarantaceæ more than 2 ovules erect in the center of the cell: fls. bisexual or, in a few genera, unisexual or polygamous; petals very rarely present; stamens as many as the perianth-segms. or fewer, rarely more.

A. Fr. the hardened or membranous closed base of the corolla-like perianth with a utricle inclosed. 145. Nyctaginaceæ.
AA. Fr. a utricle; ovule not orthotropous; embryo annular or spiral: perianth mostly persistent, small 4–5-lobed, or parted, or 0.
B. Perianth herbaceous, or scarious at the margin, persistent; stamens perigynous; style branched or styles 2–3: stipules scarious. (Illecebraceæ, incl. in Caryophyllaceæ).
BB. Perianth dry, chaff-like, not herbaceous, subtended by a bract and 2 bractlets; stamens hypogynous or perigynous; filaments coanate at base; style simple or 2–3-fid: stipules 0. 146. Amarantaceæ.
BBB. Perianth-lobes or -segms. membranous or herbaceous; stamens hypogynous or perigynous, nearly always free; style simple or 2–3-lobed, or styles 2–5: stipules none. 147. Chenopodiaceæ.

AAA. Fr. composed of 1 to several carpels, which are crowded or connate in a ring, each with a style, baccate, coriaceous or samaroid; ovule not orthotropous; embryo coiled: stamens hypogynous; perianth herbaceous or coriaceous, rarely membranous.....148. PHYTOLACCACEÆ.
AAAA. Fr. an achene, triangular or lens-shaped; style branched or styles 2–3; ovule orthotropous; embryo straight: perianth herbaceous, membranous or colored, rarely adherent to base of ovary: usually a stipular sheath at each lf.-node.....149. POLYGONACEÆ.

Series 2. MULTIOVULATÆ TERRESTRES. Terrestrial herbs or shrubs, often climbers: ovary syncarpous; ovules in each cell or on each placenta numerous.

A. Fls. dicœious; ovary superior: lvs. bearing tendrils and pitchers.....150. NEPENTHACEÆ.
AA. Fls. bisexual; ovary inferior: lvs. without tendrils and pitchers.....151. ARISTOLOCHIACEÆ.

Series 3. MICREMBRYEÆ. Ovary syncarpous, monocarpous or apocarpous; ovules solitary for each carpel, rarely 2 or few; endosperm copious, fleshy or mealy; embryo minute.

A. Perianth 0.
B. Lvs. alternate: carpels 3–4: ovules 2 to several: stamens 3–6.....152. SAURURACEÆ.
BB. Lvs. alternate, rarely opposite or whorled: carpel 1: ovule 1, basal: stamens 2–8.....153. PIPERACEÆ.
BBB. Lvs. opposite: carpel 1: ovule 1, pendent: stamens 1–3.....154. CHLORANTHACEÆ.
AA. Perianth calyx-like.
B. Carpel solitary: perianth of 3 parts, connate.....155. MYRISTICACEÆ.
BB. Carpels several, together with the stamens scattered over the face of the cup-shaped receptacle.....156. MONIMIACEÆ.

Series 4. DAPHNEÆ. Ovary monocarpous, 1-celled, rarely syncarpous with 2–4 cells; ovules solitary, or twin and side by side in the ovary or in each cell, rarely a few pairs superposed.

A. Radicle superior; ovule solitary, pendulous.
B. Anthers dehiscing by uplifting valves, rarely laterally dehiscent: perianth-tube short, lobes 6 or 4, in 2 series, usually imbricated: ovary 1-celled: woody.....157. LAURACEÆ.
BB. Anthers normal: perianth-tube long; lobes 4–5, imbricated: ovary 1–2-celled: woody.....158. THYMELÆACEÆ.
AA. Radicle inferior.
B. Perianth-tube cylindraceous; lobes 4, valvate; stamens as many and opposite them: ovule erect or pendulous, or geminate, rarely ∞.....159. PROTEACEÆ.
BB. Perianth-tube medium, constricted above the ovary, persistent at base, deciduous above; lobes 2 or 4; stamens twice as many as the lobes: silvery-scaly plants: woody.....160. ELÆAGNACEÆ.

Series 5. ACHLAMYDOSPOREÆ. Ovary 1-celled; cells 1–3-ovuled; cells and ovules often inconspicuous before anthesis; endosperm of aced without a coat, either free in the pericarp or attached to its walls: plants often parasitic.

A. Ovule 1, not easily distinguishable from ovary.....161. LORANTHACEÆ.
AA. Ovules 1–3, pendulous from summit of free-central placenta.....162. SANTALACEÆ.

Series 6. UNISEXUALES. Fls. unisexual; ovary syncarpous or monocarpous; ovule solitary or in pairs side by side in the ovary or in each cell: trees or shrubs, rarely herbs.

A. Ovary 1-celled.
B. Ovule solitary; stamens 2 to many.
C. Fls. of both sexes in globose long-peduncled pendent heads, crowded very densely on a central receptacle: radicle inferior: woody.....163. PLATANACEÆ.
CC. Fls. not as above: radicle superior.
D. Male perianth free from the bract; stamens as many as its lobes and opposite them, or by abortion fewer, rarely numerous.
E. Stamens uncoiling elastically.
F. Ovule suspended, anatropous.....164. MORACEÆ.
FF. Ovule basal, orthotropous..165. URTICACEÆ.
EE. Stamens not elastic: ovule suspended, anatropous.....166. ULMACEÆ.
DD. Male perianth wanting, sometimes grown to the bract in Juglandaceæ; stamens ∞, often 2 in Myricaceæ.
E. Lvs. pinnate: male fls. in catkins: woody.....167. JUGLANDACEÆ.
EE. Lvs. simple: male infl. spicate, subamentaceous: woody.
F. Carpel 1; placenta parietal: ovule amphitropous.....168. LEITNERIACEÆ.
FF. Carpels 2; placenta basal: ovule orthotropous.....169. MYRICACEÆ.
BB. Ovules 2; stamen 1: equisetum-like plants; woody.....170. CASUARINACEÆ.
AA. Ovary 2–3-celled, rarely more-celled.
B. Endosperm usually copious: fr. uaually separating into 2-valved berries, sometimes fleshy and indehiscent, or various; infl. various.
C. Hypogynous disk present: micropyle externally directed; juice often milky.....171. EUPHORBIACEÆ.
CC. Hypogynous disk absent: micropyle toward axis; no milky juice..172. BUXACEÆ.
BB. Endosperm 0: fr. a nut: male infl. usually in catkins: woody.
C. Carpels 2: piatillate fls. usually in spikes.....173. BETULACEÆ.
CC. Carpels 3: pistillate fls. not in spikes.....174. FAGACEÆ.

Series 7. Anomalous Families. Somewhat related to the Unisexuales.

A. Fls. in catkins: caps. 2–4-valved: woody.....175. SALICACEÆ.
AA. Fls. axillary, or rarely in a terminal head: drupe 2–∞-stoned, stonea 1-seeded: low shrubs.....176. EMPETRACEÆ.

Class 2. GYMNOSPERMÆ. Ovulea naked upon a scale, bract or disk: cotyledons 2 or more: fls. unisexual.

A. Lvs. undivided.
B. The lvs. fan-shaped: fls. in pairs.....177. GINKGOACEÆ.
BB. The lva. not fan-shaped.
C. Perianth present: no resin-tubea, but true vessels in wood.....178. GNETACEÆ.
CC. Perianth wanting: no true vessels, but resin-tubes present.
D. Ovule solitary, arillate.....179. TAXACEÆ.
DD. Ovules in cones, not arillate.....180. PINACEÆ.
AA. Lvs. pinnatisect, ample, crowded at apex of the woody st.: fls. of both aexes in cones.....181. CYCADACEÆ.

Subdivision 2. MONOCOTYLEDONS. St. without central pith or annular layers, but having the woody buodles distributed irregularly through it (a transverse section showing the bundles aa dots scattered through the cellular tissue): embryo with a single cotyledon: early lvs. always alternate: parts of the fl. usually in 3's, never in 5's: lva. mostly parallel-veined.

Series 1. MICROSPERMÆ. Perianth corolla-like, at least inside: ovary inferior, 1-celled with 3 parietal placentæ, or rarely 3-celled with axile placentæ: seeds very small and numerous; without endosperm.

A. Fls. regular, usually unisexual; stamens usually 2, 6, or 9: aquatic herbs.182. HYDROCHARITACEÆ.
AA. Fls. usually very irregular; stamens and styles connate into a column; anther 1, rarely 2: terrestrial or epiphytic herbs, rarely climbers.....183. ORCHIDACEÆ.

Series 2. EPIGYNÆ. Perianth corolla-like, at least within: ovary generally inferior: endosperm copious.

A. Fls. normally unisexual; stamens 6, or those opposite the inner perianth-lobes imperfect or deficient; ovary 3-celled: seeds 2.....184. DIOSCOREACEÆ.
AA. Fls. normally bisexual, sometimes polygamous or otherwise.
B. Stamens regular; perianth regular or nearly so: embryo small, included in the endosperm.
C. Ovary 1-celled; endosperm solid; embryo minute: stamens 6, hooded.....185. TACCACEÆ.
CC. Ovary usually 3-celled.
D. Stamens 3, opposite the outer lobes: endosperm horny.....186. IRIDACEÆ.
DD. Stamens 6, rarely 3 and opposite the inner lobes, rarely ∞: endosperm fleshy.
E. Placentæ scarcely intruding..187. AMARYLLIDACEÆ.

EE. Placentæ intruding lamella-like, and peltate.....188. VELLOSIACEÆ.
BB. Stamens 1 or 5 perfect, the other 5 or 1, variously changed into antherless staminodia; fls. irregular: embryo in a central canal of endosperm, straight, incurved, or horseshoe-shaped.
C. Fertile stamens 5.....189. MUSACEÆ.
CC. Fertile stamen 1.
D. Staminodium 1, often traces of more; a ligule at top of petiole; anther 2-celled.....190. ZINGIBERACEÆ.
DD. Staminodia 5; no ligule; anther 1-celled.
E. Ovary-cells 1-seeded: a joint at summit of petiole.....191. MARANTACEÆ.
EE. Ovary-cells ∞-seeded: no joint.192. CANNACEÆ.
BBB. Stamens regular or nearly so: perianth regular: embryo in a small marginal cave or pit of endosperm, rarely much intruded, never wholly included.
C. Endosperm mealy: perianth calyx-like outside; stamens 6: lvs. rigid.....193. BROMELIACEÆ.
CC. Endosperm fleshy: perianth corolla-like or woolly outside; stamens sometimes 6 and equal, sometimes 1–3 and slightly dissimilar, or 3 opposite the inner lobes.
(Hæmodoraceæ, mostly incl. in Liliaceæ and Amaryllidaceæ.)

Series 3. CORONARIEÆ. Perianth corolla-like, at least inside: ovary free, rarely shortly adnate at the base: endosperm copious.

A. Embryo minute or more or less elongated, included in fleshy or horny endosperm: perianth regular: stamens 6: ovary usually 3-celled.....194. LILIACEÆ.
AA. Embryo straight, in a central canal of mealy endosperm: perianth regular or irregular, from a spathe; stamens 3 or 6: ovary 1- or 3-celled.....195. PONTEDERIACEÆ.
AAA. Embryo marginal, lying in mealy endosperm and under a little callosity of the seed-coat: perianth regular or slightly irregular, of 3 herbaceous sepals and 3 deliquescent colored petals: some stamens usually sterile and altered; stamen-hairs conspicuous.....196. COMMELINACEÆ.

Series 4. CALYCINEÆ. Perianth calyx-like, small, somewhat rigid or glumaceous, or rarely herbaceous: ovary free; endosperm copious.

A. Fr. a 3-valved, many-seeded caps.; embryo included in more or less fleshy endosperm: plant grass-like....197. JUNCACEÆ.
AA. Fr. berry- or drupe-like, 1-seeded, rarely 2–3-seeded; embryo immersed in a small pit near the periphery of the endosperm: palm-like plants.....198. PALMACEÆ.

Series 5. NUDIFLORÆ. Perianth 0, or reduced to scales or bristles; ovary superior; carpels solitary or, if more, syncarpous, 1–∞-ovuled: seeds usually with endosperm.

A. Plants minute, thalloid, 1–3 lines wide, aquatic: fls. solitary or in pairs from marginal fissures.....199. LEMNACEÆ.
AA. Plants larger: fls. on spadices.
B. Fls. dicœcious; perianth 0; carpels usually confluent in clusters; spadices clustered or panicled: stiff plants.....200. PANDANACEÆ.
BB. Fls. dicœcious, or moncœcious in different spadices; perianth 0, or the short segms. distinct or connate; spadices solitary: stiff plants.....201. CYCLANTHACEÆ.
BBB. Fls. moncœcious in different spadices, rarely dicœcious; perianth reduced to membranous scales or thread-like chaff; spadices rarely solitary: reed-like marsh plants.....202. TYPHACEÆ.
BBBB. Fls. bisexual, or moncœcious in same spadix, rarely dicœcious; perianth 0, or of 4 membranous or fleshy imbricate scales; spadices solitary: herbaceous or fleshy plants.....203. ARACEÆ.

Series 6. APOCARPÆ. Perianth in 1–2 series, or 0: ovary superior; carpels solitary, or, if more, distinct: seeds without endosperm.

A. Embryo complicate or horseshoe-shaped: perianth-segms. 6, in 2 series, the inner petaloid.
B. Ovules 1, rarely 2–5, basal.....204. ALISMACEÆ.
BB. Ovules numerous, borne between the margins and midrib of the carpel....205. BUTOMACEÆ.
AA. Embryo curved: perianth of 4 herbaceous segms., or 0: ovule solitary...206. NAIADACEÆ.
AAA. Embryo straight: perianth of several petaloid parts: ovules 2–6.....207. APONOGETONACEÆ.

Series 7. GLUMACEÆ. Fls. disposed in spikes or spikelets which are variously arranged; bracts of the spikelet scale-like (glumes), usually imbricate; perianth-segms. small, scale-like, bristle-like, or 0; ovary 1-celled, 1-ovuled: seeds with endosperm.

A. Fr. an achene; seed free from the pericarp; palets and lodicules 0.....208. CYPERACEÆ.
AA. Fr. a caryopsis; seed usually adherent to pericarp; palets and lodicules present.....209. GRAMINEÆ.

Other families, of which plants are more or less in cultivation and described in this Cyclopedia, are: Adoxaceæ (Adoxa), Baselaceæ (Anredera), Candolleaceæ (Candollea), Caryocaraceæ (Caryocar), Datiscaceæ (Datisca), Frankeniaceæ (Frankenia), Goodeniaceæ (Goodenia, Scævola), Icacinaceæ (Pyrenacantha), Orobanchaceæ (Aphyllon), Restiaceæ (Restio), Turneraceæ (Turnera), Vochysiaceæ (Vochysia).

Division 2. PTERIDOPHYTA. Bearing spores instead of seeds, but with a usually separate more insignificant stage which bears sexual organs. Ferns, lycopods, horsetails and the like.

A. Plants like large moss-plants, with scale- or needle-like lvs.
B. Spores all alike, minute.....210. LYCOPODIACEÆ.
BB. Spores of two kinds, larger (megaspores) and smaller (microspores).211. SELAGINELLACEÆ.
AA. Plants consisting mainly of slender-jointed herbaceous sts. with whorls of scale-like appressed lvs. at the joints.....212. EQUISETACEÆ.
AAA. Plants true ferns, with usually expanded lvs. (Azolla, a moss-like water-plant is exceptional.) (Filicales.)
B. Ferns epiphytic or terrestrial (one Ceratopteris partly aquatic): spores uniform, minute.
C. Sporangia with thick walls, arising from tissues beneath the epidermis.
D. The sporangia in spikes or panicles.....213. OPHIOGLOSSACEÆ.
DD. The sporangia in round or oval sori on under surface of ordinary lf.....214. MARATTIACEÆ.
CC. Sporangia walls only 1 cell thick, derived from epidermis.
D. Small membranous ferns: sporangia borne on thread-like projections along margin of lvs...215. HYMENOPHYLLACEÆ.
DD. Usually larger, thicker-lvd. ferns: sporangia not on thread-like projections.
E. Plants terrestrial.
F. Ring of sporangia obsolete; sporangia in panicles.....216. OSMUNDACEÆ.
FF. Ring of sporangia apical; sporangia ovate, sessile....217. SCHIZÆACEÆ.
FFF. Ring of sporangia vertical.
G. The sporangia mostly long-stalked: lvs. pinnate or palmate.....218. POLYPODIACEÆ.
GG. The sporangia mostly sessile or very short-stalked.
H. Sporangia in sori of 2–8, radiating in a single plane; lf.-branching often dichotomous: growth indeterminate.....219. GLEICHENIACEÆ.
HH. Sporangia numerous in the globose sori: mostly arborescent...220. CYATHEACEÆ.
EE. Plants aquatic, with floating sterile lvs. and pod-like sporophylls: sporangia sessile with broad ring or 0.....221. CERATOPTERIDACEÆ.
BB. Ferns, aquatic, unfern-like in appearance; spores of 2 sorts,—large macrospores and minute microspores.
C. Plants floating: lvs. simple, folded: microspores and macrospores in separate sporocarps.....222. SALVINIACEÆ.
CC. Plants rooting in mud: lvs. quadrifoliate, cloverlike: microspores and macrospores in the same sporocarp.....223 MARSILEACEÆ.

PART II.—KEY TO THE GENERA

1. RANUNCULACEÆ.

A. Sepals usually valvate: lvs. opposite..... 1. *Clematis.*
AA. Sepals imbricate.
B. Carpels 1-ovuled: fr. an indehiscent achene.
C. Ovule pendulous; raphe dorsal.
D. Petals conspicuous..... 2. *Adonis.*
DD. Petals 0, or very small.
E. Fls. not subtended by involucres.... 3. *Thalictrum.*
EE. Fls. subtended by involucres remote from the calyx or close under it.
F. Involucre remote from calyx..... 4. *Anemone.*
FF. Involucre of 3 simple, sessile lvs. closer under the fl..... 5. *Hepatica.*
FFF. Involucre of 3 compound sessile lvs..... 6. *Syndesmon.*
CC. Ovules ascending.
D. Petals wanting..... 7. *Trautvet-[teria.*
DD. Petals 3 to many..... 8. *Ranunculus.*
BB. Carpels several- or many-ovuled: fr. usually dehiscent at maturity, rarely berry-like.
C. Petals large and showy..... 9. *Pæonia.*
CC. Petals medium small, deformed, or 0.
D. Fls. irregular.
E. Posterior sepal forms a spur.....10. *Delphinium.*
EE. Posterior sepal forms a hood.....11. *Aconitum.*
DD. Fls. regular.
E. Infl. racemose.
F. Stamens 5 or 10: shrubs.....12. *Xanthorrh-[iza.*
FF. Stamens numerous: herbs.
G. Fr. a berry.....13. *Actæa.*
GG. Fr. consisting of follicles, dehiscent.....14. *Cimicifuga.*
EE. Infl. paniculate, or fls. solitary.
F. Lvs. palmately veined or cut; not ternate.
G. Petals wanting.
H. Ovules many, in 2 series along the ventral suture....15. *Caltha.*
HH. Ovules only 2.....16. *Hydrastis.*
GG. Petals small or narrow; mostly nectar-bearing.
H. Sepals commonly deciduous; petals not 2-lipped, nor scale-bearing.....17. *Trollius.*
HH. Sepals persistent; broad petals 2-lipped or bearing a scale...18. *Helleborus.*
HHH. Sepals deciduous, narrow; petals bearing a scale.....19. *Eranthis.*
FF. Lvs. ternately or subpinnately decompound.
G. Sepals 5–6.
H. Petals spurred.....20. *Aquilegia.*
HH. Petals not spurred; often small or 0.
I. The carpels connate at the base or higher.....21. *Nigella.*
II. The carpels free.
J. Carpels stalked.....22. *Coptis.*
JJ. Carpels not stalked.....23. *Isopyrum.*
GG. Sepals and petals numerous....24. *Anemonop-[sis.*

The genus Callianthemum is also in cultivation.

2. DILLENIACEÆ.

A. Anthers adnate, linear: carpels 5–20, partly connate: upright trees or shrubs..... 1. *Dillenia.*
AA. Anthers oblong or rarely orbicular, the cells parallel and contiguous..... 2. *Hibbertia.*
AAA. Anthers versatile, emarginate at the base; carpels completely connate: fr. a berry: twining shrubs.
B. Stamens and carpels ∞: winter-buds inclosed in the swollen base of the petiole.... 3. *Actinidia.*
BB. Stamens 10: carpels 5: winter-buds free..... 4. *Clemato-[clethra.*

3. CALYCANTHACEÆ.

A. Stamens 10–∞: all sepals brownish red..... 1. *Calycanthus.*
AA. Stamens 5: outer sepals white, inner purple... 2. *Meratia.*

4. MAGNOLIACEÆ.

A. Stamens ∞: perianth-segms. 6–∞.
B. Fls. biasexual: upright trees or shrubs.
C. Stipules 0..... 1. *Illicium.*
CC. Stipules present, inclosing young lvs. in the bud.
D. Anthers face out..... 2. *Liriioden-[dron.*
DD. Anthers face in.
E. Structure bearing the carpels stalked. 3. *Michelia.*
EE. Structure bearing the carpels sessile.
F. Dehiscence of carpel circumscissile. 4. *Talauma.*
FF. Dehiscence 2-valved..... 5. *Magnolia.*
BB. Fls. unisexual: twining shrubs.
C. Carpels after anthesis spicate..... 6. *Schizandra.*
CC. Carpels after anthesis globose-capitate.... 7. *Kadsura.*
AA. Stamens 4: perianth-segms. 4; fls. in slender spikes, small: lvs. palminerved: tree..... 8. *Tetracen-[tron.*

Members of the genus Drimys are sometimes cultivated.

5. TROCHODENDRACEÆ.

A. Carpels 5–8, sessile, with many seeds: fls. perfect: evergreen tree..... 1. *Trochoden-[dron.*
AA. Carpels ∞, stipitate, developing into winged nutlets with 1 or few seeds: fls. polygamous: deciduous tree..... 2. *Euptelea.*

6. CERCIDIPHYLLACEÆ.

The only genus..... *Cercidiphyllum.*

7. EUCOMMIACEÆ.

The only genus..... *Eucommia.*

8. ANNONACEÆ.

A. Fr. an aggregation of many carpels closely crowded into a spheroid or ovoid mass; ovules solitary.
B. Carpels fused together with the receptacle (torus) into a fleshy (often edible) syncarpium.
C. Corolla gamopetalous, 3-lobed or 3-spurred, almost closed, with only a minute opening above the stamens and pistils..... 1. *Rollinia.*
CC. Corolla polypetalous; petals 6 in 2 series, inner series sometimes minute or even wanting, outer petals valvate..... 2. *Annona.*
BB. Carpels distinct, rigid, polygonal, becoming detached from the receptacle when mature; corolla polypetalous, the petals imbricate or overlapping..... 3. *Duguetia.*
AA. Fr. a cluster of distinct carpels, usually stipitate, never crowded so closely as to become polygonal or prism-shaped; ovules geminate or many in 1 or 2 series.
B. Ovules geminate, vertical, parallel..... 4. *Artabotrys.*
BB. Ovules horizontal or in 2 vertical rows.
C. Petals narrow, long, strap-shaped..... 5. *Canangium.*
CC. Petals suborbicular to obovate-oblong.
D. Inner petals with their margins involute, ear-shaped or boat-shaped..... 6. *Cymbopet-[alum.*
DD. Inner petals with margins not involute.. 7. *Asimina.*

Fusæa, Unona, Uvaria, and Xylopia are also slightly in cultivation

9. MENISPERMACEÆ.

A. Filaments coalesced into a column which is subpeltate at apex.
B. Sepals 6; petals 0..... 1. *Anamirta.*
(See article Cocculus.)
BB. Sepals 4; petals grown together, making a small cup..... 2. *Cissampelos.*
AA. Filaments free, either at base or apex.
B. Stamens 9–20.
C. Sepals and petals 6, in whorls; stamens 9–12..... 3. *Sinomen-[ium.*
CC. Sepals and petals irregularly arranged; sepals 4–10; petals 6–9; stamens 12–24... 4. *Menisper-[mum.*
BB. Stamens 6.
C. Petals 6, shorter than sepals, stamens high-monadelphous..... 5. *Cocculus.*
CC. Petals 0, unless the 3 inner and larger sepals are regarded as petals; outer stamens free..... 6. *Abuta.*

Calyocarpum and Jatrorrhiza are sometimes cultivated.

10. BERBERIDACEÆ.

A. Venation or lobing pinnate; lvs. penninerved, pinnatisect, pinnately 2–3-ternate or decompound.
B. Ovules few, erect from the base.
C. Plants are shrubs.
D. Foliage-lvs. simple, often fascicled: branches usually bearing reduced spine-lvs. ..... 1. *Berberis.*
DD. Foliage-lvs. pinnate: evergreen branches unarmed.
E. Lfts. serrate; lvs. simply pinnate..... 2. *Mahonia.*
EE. Lfts. entire; lvs. 2–3-pinnate..... 3. *Nandina.*
CC. Plants are herbs.
D. Petals 6, reduced to small nectaries..... 4. *Leontice.*
DD. Petals 6, scarcely smaller than sepals and flat..... 5. *Leontice,* § *Bongardia.*
BB. Ovules placed ventrally in 2 series: herbs.
C. Sepals 12–15; petals 0, reduced to nectaries..... 6. *Vancouveria.*
CC. Sepals 8; petals 4, reduced to nectaries.... 7. *Epimedium.*
CCC. Sepals 7–8; petals 4, a little smaller: flat... 8. *Aceranthus.*
AA. Venation or lobing palmate; lvs. palminerved, palmilobed, or 2-parted.
B. Sepals 6; petals 6: ovules in 2 series..... 9. *Diphylleia.*
BB. Sepals 6; petals 6–9: ovules in many series...10. *Podophyllum.*
BBB. Sepals 4; petals 8.....11. *Jeffersonia.*
BBBB. Sepals and petals 0.....12. *Achlys.*

The species of Caulophyllum may be expected in wild gardens.

11. LARDIZABALACEÆ.

A. Lvs. pinnate: upright shrub..... 1. *Decaisnea.*
AA. Lvs. digitate: twining shrubs.
B. Carpels 3, many-seeded.
C. Stamens monadelphous.
D. Sepals 6; petals 6, much smaller..... 2. *Lardizabala.*
DD. Sepals 6; petals 0..... 3. *Stauntonia.*
CC. Stamens free.
D. Sepals 6; petals 6.
E. Pedicels elongated; sepals acuminate; connective produced above the anthers..... 4. *Holbœllia.*
EE. Pedicels short; sepals rounded; connective not produced; racemes very long..... 5. *Sinofranchetia.*
DD. Sepals 3; petals 0..... 6. *Akebia.*
BB. Carpels ∞, 1-seeded; stamens free: lvs. deciduous..... 7. *Sargentodoxa.*

12. NYMPHÆACEÆ.

A. Fls. small (½–1 in.).
B. Stamens 3–6: submerged lvs. dissected..... 1. *Cabomba.*
BB. Stamens 12–25: lvs. all peltate..... 2. *Brasenia.*
AA. Fls. large and showy (1½–12 in.); sepals 4–5; petals and stamens ∞.
B. Carpels in pits in a top-shaped receptacle.... 3. *Nelumbo.*
BB. Carpels forming a distinct many-seeded ovary.
C. Plants prickly.
D. Stamens, inner ones, sterile..... 4. *Victoria.*
DD. Stamens all fertile..... 5. *Euryale.*
CC. Plants not prickly.
D. Ovary wholly free and superior..... 6. *Nuphar.*
DD. Ovary with stamens and inner petals inserted on it..... 7. *Nymphæa.*

13. SARRACENIACEÆ.

A. Style umbrella-shaped..... 1. *Sarracenia.*
AA. Style 5-cut at apex..... 2. *Darlingtonia.*

Heliamphora may be expected in choice botanical collections.

14. PAPAVERACEÆ.

A. Stigmas distinct: lvs. mainly opposite or whorled: sepals usually 3; petals usually 6, in 2 series: placentæ never separate from the valves.
B. Lvs. lobed..... 1. *Romneya.*
BB. Lvs. entire.
C. Filaments dilated: stigmas ∞, linear: fr. not capsular..... 2. *Platystemon.*
CC. Filaments slightly dilated; stigmas 3, broader: fr. capsular..... 3. *Platystigma.*
AA. Stigmas confluent: lvs. alternate, ternately decompound: sepals 2; petals 4: placentæ remain attached to the margin of the valves.
B. Sepals coherent and covering fl. like a candle-extinguisher..... 4. *Eschscholtzia.*
BB. Sepals separate.
C. Lobes of stigma 2, erect..... 5. *Dendrocon.*
CC. Lobes of stigma 4, spreading..... 6. *Hunnemannia.*
AAA. Stigmas confluent: lvs. alternate or mainly so: fls. rarely 3-merous: caps. dehiscing by pores or valves, the placentæ remaining as a frame alternate with and free from the valves.
B. Caps. dehiscent by pores near the top..... 7. *Papaver.*
BB. Caps. shortly dehiscing by valves.
C. Stigmatic lobes radiating on the depressed summit of a very short style.... 8. *Argemone.*
CC. Stigmatic lobes radiating on the club-shaped top of a distinct style..... 9. *Meconopsis.*
BBB. Caps. dehiscing by valves to the base or nearly so.
C. The caps. long and linear.
D. Seeds pitted.....10. *Glaucium.*
DD. Seeds crested.....11. *Chelidonium.*
CC. The caps. ovoid, oblong or cylindrical.
D. Petals 4.
E. Style distinct, but short.....12. *Stylophorum.*
EE. Style long.....13. *Eomecon.*
DD. Petals 8–12.....14. *Sanguinaria.*
DDD. Petals 0.....15. *Bocconia.*

Hypecoum is in the trade.

15. FUMARIACEÆ.

A. Corolla 2-spurred or bigibbous, the 2 outer and larger (lateral) petals similar.
B. Seeds crestless: petals permanently united into a subcordate persistent corolla which incloses the ripe caps..... 1. *Adlumia.*
BB. Seeds mostly crested: petals less or slightly united into a 2-spurred or bigibbous corolla..... 2. *Dicentra.*
AA. Corolla with only 1 of the outer petals spurred or gibbous by torsion becoming posterior: a nectariferous spur from the base of the filaments projects into the petal-spur.
B. Style mostly persistent..... 3. *Corydalis.*
BB. Style deciduous: fl. smaller..... 4. *Fumaria.*

16. CRUCIFERÆ.

A. The silique transversely 2-jointed.
B. Lower joint indehiscent pedicel-shaped, the larger joint globose, 1-loculed, 1-seeded... 1. *Crambe.*
BB. Lower joint dehiscent, 2-valved, many seeded..... 2. *Morisia.*
AA. The silique not 2-jointed, indehiscent.
B. Siliques in pairs..... 3. *Senebiera.*
BB. Siliques not in pairs.
C. Texture horny or bony..... 4. *Isatis.*
CC. Texture leathery, or membranaceous.
D. Shape straight..... 5. *Raphanus.*
DD. Shape curved..... 6. *Sobolewskia.*
DDD. Shape orbicular..... 7. *Peltaria.*
AAA. The silique dehiscent for its whole length (except that some Brassicas are not dehiscent at the apex).
B. Valves markedly concave, compressed contrary to the septum, which is often very narrow; silique short.
C. Cotyledons accumbent.
D. Sts. leafy..... 8. *Iberis.*
DD. Sts. scapes..... 9. *Hutchinsia.*
CC. Cotyledons incumbent.
D. The valves usually wingless.
E. Fls. rosy or violet.....10. *Ionopsidium.*
EE. Fls. white.....11. *Lepidium.*
DD. The valves winged.....12. *Æthionema.*
BB. Valves (transversely septiferous in Anastatica), flat or concave, not compressed contrary to the septum (Smelowskia and certain Vesicarias are laterally compressed): septum as wide as the valves; silique long or short.
C. Cotyledons longitudinally conduplicate.
D. Seeds in 1 series.....13. *Brassica.*
DD. Seeds in 2 series.....14. *Eruca.*
CC. Cotyledons accumbent (sometimes incumbent or convolute in Cheiranthus).
D. Seeds in 1 series (except certain species of Radicula and Arabis: siliques long and narrow (except in Anastatica and sometimes Radicula and Parrya).

E. Valves appendaged.....15. *Anastatica.*
(See article Resurrection Plants.)
EE. Valves not appendaged.
F. Stigmatic lobes erect, connate or decurrent along the style.
G. Plants are herbs or branched sub-shrubs: woolly.....16. *Matthiola.*
GG. Plants are tufted, scape-bearing herbs.....17. *Parrya.*
FF. Stigma undivided or shortly lobed.
G. Valves elastic: seeds in 1 or 2 series, silique long and linear...18. *Arabis.*
GG. Valves not elastic.
H. Sepals unequal, the lateral ones saccate at the base....19. *Cheiranthus.*
HH. Sepals equal.
I. Seeds in 2 series.....20. *Radicula.*
II. Seeds in 1 series.
J. Fls. yellow.....21. *Barbarea.*
JJ. Fls. white or purple.
K. Rhizome not scaly: valves delicately net-ted-nerved.....22. *Cardamine.*
KK. Rhizome scaly: valves with very delicate midrib.....23. *Dentaria.*
DD. Seeds in 2 series and siliques short and broad (except in some species of Aubrietia, Draba and Cochlearia).
E. Siliques 2-locular, many-seeded; seeds much compressed, winged or margined.
F. Lvs. entire or dentate: siliques long-stalked, very broad.....24. *Lunaria.*
FF. Lvs. pinnatisect: siliques sessile...25. *Selenia.*
EE. Siliques 1–2-loculed, 2- to many-seeded; seeds rarely winged; valves often turgid.
F. Sepals often unequal, the lateral saccate at the base.
G. Fls. purple: siliques oblong: lateral sepals saccate.....26. *Aubrietia.*
GG. Fls. generally yellow: siliques mostly oblong: sepals equal or unequal.....27. *Vesicaria.*
FF. Sepals equal.
G. Stamens often appendaged.....28. *Alyssum.*
GG. Stamens not appendaged.
H. Plants tomentose.....29. *Draba.*
HH. Plants glabrous.....30. *Cochlearia.*
(See also Kernera.)
CCC. Cotyledons incumbent, straight, convolute or transversely plicate.
D. The cotyledons transversely biplicate...31. *Heliophila.*
DD. The cotyledons not transversely biplicate.
E. Petals pinnatifid.....32. *Schizopetalon.*
EE. Petals not pinnatifid.
F. Stigmas erect, free or connate into a cone; sepals long and straight.
G. The stigmas bilamellate; lamellæ erect.....33. *Hesperis.*
GG. The stigmas bilamellate; lamellæ connivent or connate into a cone.....34. *Malcomia.*
FF. Stigma simple, capitate, emarginate or shortly 2-lobed: cotyledons straight
G. Silique stipitate.....35. *Stanleya.*
GG. Silique sessile.
H. Sepals equal.....36. *Smelowskia.*
HH. Sepals unequal.....37. *Erysimum.*

The additional genera are also treated: Braya, Physaria, and Physoptychis.

17. CAPPARIDACEÆ.

A. Fr. capsular, 1-loculed: herbs.
B. Torus short, often produced into a posterior appendage..... 1. *Cleome.*
BB. Torus long, produced into a gynophore which is elongated at the middle and bears the pistil to which the filaments are united..... 2. *Gynandropsis.*
AA. Fr. berry-like or drupe-like.
B. Lvs. simple..... 3. *Capparis.*
BB. Lvs. with 3 lfts..... 4. *Cratæva.*

Polanisia is also to be expected in cultivation.

18. RESEDACEÆ.

In cultivation..... *Reseda.*

19. CISTACEÆ.

A. Placentæ with many seeds: lvs. opposite at least below, flat.
B. Valves 5, rarely 3; embryo circinate or spiral: fls. solitary or cymose, rarely racemose..... 1. *Cistus.*
BB. Valves 3; embryo biplicate, runcinate or circumflex: fls. commonly racemose..... 2. *Helianthemum.*
AA. Placentæ with 2 seeds: lvs. alternate, scale-like or awl-shaped: heath-like shrubs..... 3. *Hudsonia.*

20. VIOLACEÆ.

A. Sepals subequal, produced or spurred at base; lower petal spurred or saccate: herbs..... 1. *Viola.*
AA. Sepals not produced at base.
B. Lower petal spurred or enlarged.
C. With a very large spur: seeds complanate: woody climber..... 2. *Corynostylis.*
CC. With lower petal merely gibbous: seeds obovoid-subglobose: herbs..... 3. *Solea.*
BB. Lower petal not greatly unlike the others: shrubs or trees..... 4. *Hymenanthera*

21. BIXACEÆ.

A. Caps. 2-valved; seeds straight and naked: lvs. entire..... 1. *Bixa.*
AA. Caps. 3-valved: seeds spiral, hairy or woolly: lvs. digitate or palmately lobed..... 2. *Maximilianea.*

22. FLACOURTIACEÆ.

A. Sepals and petals alike, 9–15, spirally arranged, red; stamens 7–10: twining shrub.. 1. *Berberidopsis.*
AA. Sepals 3–6, whorled; stamens usually numerous (except in No. 4): upright trees or shrubs.
B. Petals 4–10; sepals 3–5..... 2. *Oncoba.*
BB. Petals wanting.
C. Infl. axillary: lvs. penninerved, leathery: fr. a berry or drupe.
D. Style simple, sometimes lobed at apex; ovary 1-celled.
E. The sepals imbricate; style short..... 3. *Xylosma.*
EE. The sepals valvate; style elongated; stamens sometimes 5 or 10..... 4. *Azara.*
DD. Styles several; ovary irregularly divided.
E. Fls. perfect or polygamous, in axillary racemes or panicles: fr. a drupe..... 5. *Flacourtia.*
EE. Fls. dicœcious, the pistillate solitary or few: fr. a berry..... 6. *Aberia*
CC. Infl. terminal: lvs. hand-nerved or 3-nerved at base, long-stalked, deciduous. (or *Doryalis.*)
D. Fr. a berry; styles usually 5; sepals imbricate..... 7. *Idesia.*
DD. Fr. a caps.
E. Styles 3, 2-parted at apex; sepals valvate..... 8. *Poliothyrsis.*
EE. Styles 3–4, 3-parted at apex; sepals reduplicate, large..... 9. *Carrierea.*

23. PITTOSPORACEÆ.

A. Fr. indehiscent.
B. Filaments longer than anthers; petals more or less connivent from the base to beyond the middle..... 1. *Billardiera.*
BB. Filaments shorter than anthers; petals spreading from the base..... 2. *Sollya.*
AA. Fr. a caps. which is loculicidally dehiscent.
B. Caps. thick-coriaceous; seeds numerous.
C. Seeds not winged, thick or slightly compressed..... 3. *Pittosporum.*
CC. Seeds winged, flat, compressed, horizontal. 4. *Hymenosporum*
BB. Caps. thinly coriaceous: seeds 1–2 in each locule, compressed, not winged, vertical... 5. *Bursaria.*

24. TREMANDRACEÆ.

A. Anthers 2-celled, or 4-celled in 2 planes..... 1. *Tetratheca.*
AA. Anthers 4-celled in 1 plane..... 2. *Platytheca.*

25. POLYGALACEÆ.

In cultivation..... *Polygala.*

26. CARYOPHYLLACEÆ.

A. Ovary 1-ovuled: corolla absent.
B. Segms. of involucrate perianth hooded near apex and mucronate on back..... 1. *Paronychia.*
BB. Segms. of hardly involucrate perianth not hooded, and blunt..... 2. *Herniaria.*
AA. Ovary several-ovuled: petals usually present.
B. Sepals coalesced into a toothed or lobed calyx; petals and stamens hypogynous, being raised with the ovary on a gynophore, rarely sessile; petals with or without a scale at the apex of the claw.
C. Hilum facial; embryo straight.
D. Calyx tubular, multistriate..... 3. *Dianthus.*
DD. Calyx top-shaped or long-tubular, 5- or 15-ribbed: plants and fls. smaller..... 4. *Tunica.*
CC. Hilum lateral; embryo peripheral.
D. Calyx 10-nerved, rarely with many parallel nerves.
E. Styles commonly 3: caps. shortly 3- or 6-valved..... 5. *Silene.*
EE. Styles commonly 5 or 4: caps. shortly 5–10- or 4–8-valved..... 6. *Lychnis.*
DD. Calyx obscurely veined..... 7. *Saponaria.*
DDD. Calyx broadly or obscurely 5-nerved.... 8. *Gypsophila.*
BB. Sepals free or only coalesced at the very base; petals and stamens hypogynous on a short torus or usually very shortly perigynous.
C. Stipules small, scarious..... 9. *Spergula.*
CC. Stipules 0.
D. Valves (or rather teeth) of the caps. twice as many as the styles.....10. *Cerastium.*
DD. Valves of the caps. as many as the styles.
E. Petals 2-fid; styles commonly 3.....11. *Stellaria.*
EE. Petals entire; styles commonly 3.....12. *Arenaria.*
EEE. Petals entire or 0; styles as many as the sepals.....13. *Sagina.*

Alsine is also cultivated.

27. PORTULACACEÆ.

A. Ovary cohering below with the calyx-tube..... 1. *Portulaca.*
AA. Ovary free from the calyx.
B. Embryo arched; endosperm scant..... 2. *Anacampseros.*
BB. Embryo more incurved or annular, including the endosperm.
C. Sepals usually deciduous..... 3. *Talinum.*
CC. Sepals persistent, at least usually in Calandrinia.
D. Number of sepals 5–8..... 4. *Lewisia.*
DD. Number of sepals 2.
E. Shape of sepals roundish heart-shaped, scarious..... 5. *Spraguea.*
EE. Shape of sepals ovate, herbaceous.
F. Stamens 3, rarely 5..... 6. *Montia.*
FF. Stamens definitely 5..... 7. *Claytonia.*
FFF. Stamens indefinitely 5 to many... 8. *Calandrinia.*

28. TAMARICACEÆ.

A. Stamens 4–5, free..... 1. *Tamarix.*
AA. Stamens 10, connate below..... 2. *Myricaria.*

29. FOUQUIERIACEÆ.

The only genus..... *Fouquieria.*

30. HYPERICACEÆ.

A. Fls. 4-merous..... 1. *Ascyrum.*
AA. Fls. 5-merous..... 2. *Hypericum.*

31. GUTTIFERÆ.

A. Style very short or 0: ovules solitary in each locule of the ovary.
B. Sepals 4..... 1. *Garcinia.*
BB. Sepals 2..... 2. *Rheedia.*
AA. Style elongated: ovules solitary or 2.
B. Ovary 1-loculed, 1-ovuled..... 3. *Calophyllum.*
BB. Ovary 2–4-loculed, 4-ovuled..... 4. *Mammea.*

The genera Ochrocarpus and Platonia are also treated.

32. EUCRYPHIACEÆ.

The only genus..... *Eucryphia.*

33. TERNSTRŒMIACEÆ.

A. Anthers basifixed.
B. Calyx of 5 sepals, sub-connate at the base, at length fleshy and adhering to the ovary... 1. *Visnea.*
BB. Calyx inferior; sepals free.
C. Fls. rather large; petals coalesced at base; anthers glabrous: ovules 2–4 in each locule, pendulous from the apex..... 2. *Ternstrœmia.*
CC. Fls. medium-sized; petals free or hardly coalesced; anthers pilose: ovules ∞ in the middle of the locule..... 3. *Cleyera.*
CCC. Fls. small, dioecious; petals coalesced at base; anthers glabrous: ovules ∞ in the middle of the locule..... 4. *Eurya.*
AA. Anthers versatile.
B. Radicles inferior.
C. Ovules ascending; seeds lens-shaped; embryo straight..... 5. *Stuartia.*
CC. Ovules laterally affixed; seeds flat, winged on back; cotyledons flat and radicle inflexed..... 6. *Schima.*
BB. Radicles superior.
C. Ovules ∞; seeds winged above..... 7. *Gordonia.*
CC. Ovules few in each locule; seeds not winged.
D. Fls. sessile; sepals deciduous..... 8. *Camellia.*
DD. Fls. pedicelled; sepals persistent..... 9. *Thea.*

34. STACHYURACEÆ.

The only genus..... *Stachyurus.*

35. MALVACEÆ.

A. Fr. a caps., loculicidally dehiscent (in Adansonia indehiscent, and woody).
B. Seeds usually kidney-shaped: stigmas or style-branches finally spreading.
C. Bractlets 5 to many, rarely 0, or reduced to teeth: style-branches finally spreading..... 1. *Hibiscus.*
CC. Bractlets 0 or 3: stigmas distinct, free, radiating..... 2. *Lagunaria.*
BB. Seeds obovoid or angled: style club-shaped at apex, undivided or with short erect branches.
C. Bractlets 3–5, small..... 3. *Thespesia.*
CC. Bractlets 3, large, cordate..... 4. *Gossypium.*
AA. Fr. composed of carpels which separate at maturity.
B. Staminal column anther-bearing outside; truncate or 5-toothed at the apex; style-branches 10.
C. Bractlets 5–8, herbaceous or setiform; carpels with or without 1–3 awns..... 5. *Pavonia.*
CC. Bractlets ∞, herbaceous or setiform; carpels fleshy outside, connate into a berry, later separating..... 6. *Malvaviscus.*
CCC. Bractlets 4–6, large and colored; carpels naked, muticous..... 7. *Gaethea.*
BB. Staminal column bearing anthers at or near the apex.
C. Carpels ∞, crowded into a mass without order.
D. Bractlets 3..... 8. *Malope.*
DD. Bractlets 0..... 9. *Palava.*
CC. Carpels in a single whorl.
D. Ovules 2 or more.
E. Bractlets 4–6.....10. *Kydia.*
EE. Bractlets 0.....11. *Abutilon.*
EEE. Bractlets 3.....12. *Sphæralcea.*
DD. Ovule solitary.
E. The ovule ascending.
F. Styles longitudinally stigmatose inside.
G. Fls. dioecious.....13. *Napæa.*
GG. Fls. bisexual. (See article Sida.)
H. Staminal column double, the outer of 5 clusters.....14. *Sidalcea.*
HH. Staminal column single.
I. Bractlets 3–9, connate at base.
J. Axis of fr. not surpassing carpels.....15. *Althæa.*
JJ. Axis of fr. surpassing carpels.....16. *Lavatera.*
II. Bractlets 0–3, distinct.
J. Carpels with transverse appendages inside under the beak.....17. *Callirhoë.*

JJ. Carpels not appendaged..18. *Malva.*
FF. Style-branches tipped with small capitate or club-shaped stigmas..19. *Malvastrum.*
EE. The ovules pendulous.
F. Style-branches longitudinally stigmatose inside.....20. *Plagianthus.*
FF. Style-branches truncate at apex or with small capitate stigmas.....21. *Sida.*

Other genera described are Hoheria, Ingenhousia, Kitaibelia, and Kosteletzkya.

36. BOMBACACEÆ.

A. Lvs. digitate: cotyledons conduplicate or convolute.
B. Staminal column separated above into numerous filaments.
C. Caps. 5-valved, densely woolly within ... 1. *Bombax.*
CC. Caps. woody, not woolly within.
D. Calyx 5-cut..... 2. *Adansonia.*
DD. Calyx truncate..... 3. *Pachira.*
BB. Staminal column 5-cut or 5-toothed, the branches bearing 2–3 anthers.
C. Column outside below the middle annulately 5–10-lobed..... 4. *Chorisia.*
CC. Column not annulate..... 5. *Ceiba.*
AA. Lvs. simple, feather-veined, entire: cotyledons plane, leafy or fleshy..... 6. *Durio.*

37. STERCULIACEÆ.

A. Petals concave or hooded at the base.
B. Anthers solitary between the staminodes.... 1. *Rulingia.*
BB. Anthers 2 or more between the staminodes.
C. Fr. a membranous caps..... 2. *Abroma.*
CC. Fr. a woody caps..... 3. *Guazuma.*
CCC. Fr. drupaceous..... 4. *Theobroma.*
AA. Petals flat.
B. The petals deciduous.
C. Anthers sessile; calyx club-shaped or bell-shaped..... 5. *Reevesia.*
CC. Anthers stipitate; sepals at length free.. 6. *Pterospermum.*
BB. The petals persistent or marcescent.
C. Anthers 10 or 15, rarely 20.
D. Ovules 2 in each locule..... 7. *Dombeya.*
DD. Ovules ∞..... 8. *Pentapetes.*
CC. Anthers 5..... 9. *Mahernia.*
AAA. Petals 0.
B. Fls. bisexual..... 10. *Fremontia.*
BB. Fls. unisexual or polygamous.
C. Anthers crowded without order: seeds without endosperm..... 11. *Sterculia.*
CC. Anthers in a single ring: seeds with endosperm..... 12. *Cola.*

Brachychiton, Chiranthodendron, and Heritiera are also treated

38. TILIACEÆ.

A. Calyx bell-shaped, 3–5-cut..... 1. *Berria.*
AA. Calyx composed of distinct sepals.
B. Petals pitted at the base, inserted around the base of a more or less elevated torus.
C. Fr. unarmed, glabrous, or tomentose .... 2. *Grewia.*
CC. Fr. echinate or setose ..... 3. *Triumfetta.*
BB. Petals not pitted, inserted immediately around the stamens.
C. Fr. indehiscent globose, usually 1-seeded... 4. *Tilia.*
CC. Fr. a caps.
D. Caps. loculicidally dehiscent.
E. The stamens all bear anthers.
F. The caps. globose, echinate..... 5. *Entelea.*
FF. The caps. pod-like, usually naked.. 6. *Corchorus.*
EE. The outer stamens have no anthers... 7. *Sparmannia.*
DD. Caps. dehiscing at the apex..... 8. *Luehea.*

39. ELÆOCARPACEÆ.

A. Fr. a berry..... 1. *Aristotelia.*
AA. Fr. a drupe..... 2. *Elæocarpus.*
AAA. Fr. a dehiscent loculicidal caps..... 3. *Tricuspidaria.*

40. LINACEÆ.

A. Styles 5: lvs. entire: glands equal..... 1. *Linum.*
AA. Styles 3–4: lvs. usually serrate: glands usually unequal or absent..... 2. *Reinwardtia.*

41. ERYTHROXYLACEÆ.

In cultivation ..... *Erythroxylon.*

42. MALPIGHIACEÆ.

A. Fr. a fleshy 3-stoned drupe..... 1. *Malpighia.*
AA. Fr. a caps. composed of 3 dehiscent berries: fls. in terminal racemes..... 2. *Galphimia.*
AAA. Fr. consists of 1–3 samaras: fls. in umbel-like corymbs..... 3. *Stigmaphyllon.*

Other genera described are Byrsonima, Janusia, Sphedamnocarpus and Tristellateia.

43. ZYGOPHYLLACEÆ.

A. Ovary sessile: lvs. with 2 lfts., rarely 1 lft... 1. *Zygophyllum.*
AA. Ovary stalked: lvs. abruptly pinnate..... 2. *Guaiacum.*

44. GERANIACEÆ.

A. Fls. irregular, the posterior sepal spurred; spur aduate to the pedicel..... 1. *Pelargonium.*
AA. Fls. regular or nearly so.
B. Stamens 10, usually all fertile: tails of carpels usually not bearded inside..... 2. *Geranium.*
BB. Stamens, 5 fertile and 5 reduced to scales; tails of carpels usually bearded inside..... 3. *Erodium.*
BBB. Stamens 15, anther-bearing, in groups of 5.. 4. *Monsonia.*

45. TROPÆOLACEÆ.

The only genus..... *Tropæolum.*

46. LIMNANTHACEÆ.

In cultivation ..... *Limnanthes.*

47. OXALIDACEÆ.

A. Fr. a loculicidal caps.
B. Valves of caps. separating to the middle.... 1. *Oxalis.*
BB. Valves of caps. separating to the base..... 2. *Biophytum.*
AA. Fr. an indehiscent berry..... 3. *Averrhoa.*

48. BALSAMINACEÆ.

In cultivation ..... *Impatiens.*

49. RUTACEÆ.

A. Ovary entire or slightly 2–5-lobed; style terminal, entire at base: fr. drupe-like or berry-like, but leathery, usually indehiscent.
B. Fls. hermaphrodite; petals and stamens free or connate; ovules 1, 2 or many: fr. usually with a cortex outside and pulpy within; seeds ex-albuminous. (Subfamily Citratæ.)
C. Cotyledons thin and twisted in seed: frs. dry..... 1. *Micromelum.*
CC. Cotyledons thick and fleshy, plano-convex: frs. more or less fleshy or pulpy.
D. Thorns absent: lvs. pinnate; lfts. alternate on rachis: frs. fleshy berries.
E. Styles very short and thick, persistent; fls. small, urceolate: young growth densely covered with brown velvety pubescence..... 2. *Glycosmis.*
EE. Styles long or, if short, dehiscent.
F. Fls. small: ovarial cells with scattered hairs: frs. with thick fleshy dissepiments..... 3. *Clausena.*
FF. Fls. large: ovarial cells with tufted conducting hairs: frs. fleshy but with thin dissepiments..... 4. *Chalcas.*
DD. Thorns usually present: lvs. simple or, if compound, with the lateral lfts. exactly opposite. (Trihe Citreæ.)
E. Frs. large, hard-shelled; cells filled with mucilage. (Subtribe Æglineæ.)
F. Lvs. pinnate: ovary 5-celled but by confluence becoming 1-celled.
G. Seeds woolly; exocarp woody, continuous..... 5. *Feronia.*
GG. Seeds smooth; exocarp prismatic. 6. *Feroniella.*
FF. Lvs. trifoliate or simple: ovary 6–15-celled.

GG. The lvs. always simple: fr. with thin dissepiments, 6-celled; seeds smooth ..... 7. *Ægiopsis.*
GG. The lvs. trifoliate: fr. 8–15-cellad.
H. Seeds woolly.
I. The frs. hard-shelled, 10–15-celled ..... 8. *Ægle.*
II. The frs. long-oval, leathery, 8–10-celled ..... 9. *Chætosper-*
HH. Seeds smooth: fr. subgloboae, very hard-shelled ..... 10. *Balsamo-* [*mum.* [*citrus.*
EE. Frs. not hard-shelled. (Subtribe Lavanginæ.)
F. The frs. small, fleshy or with mucilage in cells, without pulp-vesicles.
G. Petioles very long; lvs. trifoliate: climbing shrubs ..... 11. *Lavanga.*
GG. Petioles short, often winged.
H. The lvs. pinnate; rachis broadly winged: frs. ½in. diam. ..... 12. *Hespere-*
HH. The lvs. trifoliate or simple. [*thusa.*
I. Lvs. trifoliate or bifoliate.
J. Petioles of medium length, narrowly winged: frs. 1 in. diam. ..... 13. *Pleiasper-*
JJ. Petioles very short, wingless: fls. 3-merous: frs. ½in. diam. ..... 14. *Triphasia.* [*mium.*
II. Lvs. simple or unifoliate.
J. Frs. angled; seeds very long, flattened ..... 15. *Merope.*
JJ. Frs. not angled.
K. Plant a climbing shrub: petioles long ..... 16. *Paramignya.*
KK. Plant a shrub or tree: petioles short.
L. Diam. of frs. ½in.: lvs. venose: cells not filled with mucilage ..... 17. *Severinia.*
LL. Diam. of frs. 1 in.: cells filled with mucilage: lvs. smooth ..... 18. *Pamburus.*
FF. The frs. hesperidia, the cells filled with stalked pulp-vesicles containing juice. (Subtribe Citrinæ.)
G. Lvs. pinnate; rachis broadly winged: ovules 1 in each cell . 19. *Citropsis.*
GG. Lvs. trifoliate or simple: ovules usually 2 or more in each cell.
H. The lvs. trifoliate, deciduous. 20. *Poncirus.*
HH. The lvs. simple, persistent.
I. Stamens 8 or 10, twice as many as the petals ..... 21. *Atalantia.*
II. Stamens 16–40, 4 or more times as many as petals.
J. Lvs. isofacial, gray-green, with stomates and hairs on both faces: frs. small, 3–4-celled ..... 22. *Eremocitrus.*
JJ. Lvs. not isofacial, without stomates on upper surface.
K. Ovary 3–5-celled: lvs. pale below, punctate.. 23. *Fortunella.*
KK. Ovary 6–15-celled.
L. The stamens polyadelphous ..... 24. *Citrus.*
LL. Stamens free.
M. Cotyledons aërial on germination; first foliage lvs. opposite: fr. small, 10–12-celled ..... 25. *Papeda.*
MM. Cotyledons hypogeous; first foliage-lvs. alternate cataphylls: frs. 5- or 6-celled. 26. *Microcitrus.*
BB. Fls. usually polygamo-dicœcious; petals and atamens free; ovulea 2, except in the first 2 genera: aeeds usually albuminous.
C. Ovules solitary.
D. Petals 4–5, valvate; stamens 4–5: drupe 2–4-stoned ..... 27. *Skimmia.*
DD. Petals 5, valvate; stamens 5; ovary 5-lobed; stigma sessile ..... 28. *Casimiroa.*
CC. Ovulea twin.
D. Petals 2–5, valvate or imbricate; stamens 2–5: fr. 4–7-loculed ..... 29. *Toddalia.*
DD. Petals 5–8, valvate; atamens 5–6: fr. a 5-stoned drupe ..... 30. *Phellodendron.*
DDD. Petals 4–5, imbricate; stamens 4–5: fr. a 2–3-loculed samara ..... 31. *Ptelea.*
AA. Ovary deeply 2–5-lobed; styles basilar or ventral, or the stigmas connate: fr. capsular or 3–5-berried.
D. Ovules 3 or more in each locule.
C. Petals 4–5, equal; stamens 8–10, straight . 32. *Ruta.*
CC. Petals 5, unequal; stamens 10, declinate.. 33. *Dictamnus.*
BB. Ovules 2 in each locule.
C. Fls. irregular ..... 34. *Ravenia.*
CC. Fls. regular.
D. The fls. unisexual or polygamous.
E. Lvs. alternate.
F. Foliage pinnate: fls. polygamous.. 35. *Xanthoxy-*
FF. Foliage simple: fls. unisexual ..... 36. *Orixa.* [*lum.*
EE. Lvs. opposite: fls. unisexual ..... 37. *Evodia.*
DD. The fls. hermaphrodite.
E. Albumen fleshy (unknown in Choisya).
F. Petals erect, long, connate or connivent, forming a cylindrical tube ..... 38. *Correa.*
FF. Petals free, spreading.
G. The petals imbricate.
H. Stamens 8; petals 4: lvs. opposite ..... 39. *Boronia.*
HH. Stamens 8–10; petals 4–5: lvs. alternate ..... 40. *Eriostemon.*
HHH. Stamens 10; petals 5: lvs. opposite ..... 41. *Choisya.*
GG. The petals valvate ..... 42. *Pilocarpus.*
EE. Albumen 0.
F. The caps. 5-loculed ..... 43. *Calodendrum.*
FF. The ovary-lobes 1–5, free.
G. Staminodes 0 ..... 44. *Diosma.*
GG. Staminodes 5.
H. Style short; stigma capitate; fls. terminal ..... 45. *Adenandra.*
HH. Style long; stigma simple; fls. axillary ..... 46. *Barosma.*

The following genera are also described: Amyris, Chloroxylon, Diplolæna, Limonia, and Spathelia.

50. SIMARUBACEÆ.

A. Stamens 10, twice as many as petals.
B. Petals united into a tube ..... 1. *Quassia.*
BB. Petals spreading ..... 2. *Ailanthus.*
AA. Stamens 4–5, as many as petals ..... 3. *Picrasma.*

51. OCHNACEÆ.

A. Ovary 3–10-loculed: locules 1-ovuled; seeds without endosperm.
B. Stamens many; panicle lateral ..... 1. *Ochna.*
BB. Stamens 10; panicle terminal ..... 2. *Ouratea.*
AA. Ovary 2–5-loculed, many-ovuled, with endosperm ..... 3. *Cespedesia.*

52. BURSERACEÆ.

A. Calyx-tube broadly urn-shaped, covered by the torus ..... 1. *Garuga.*
AA. Calyx small, 4–6-parted ..... 2. *Bursera.*

53. MELIACEÆ.

A. Stamens free.
B. Ovary 4–5-celled; cells 8–12-ovuled ..... 1. *Cedrela.*
BB. Ovary 2-celled; cells 1-ovuled ..... 2. *Ptæroxylon.*
AA. Stamens coalesced into a tube, at least at base.
B. Locules of the ovary many-ovuled ..... 3. *Swietenia.*
BB. Locules of the ovary 1–2-ovuled.
C. Lvs. simple ..... 4. *Turræa.*
CC. Lvs. 3-foliolate or 1–3-pinnate.
D. Anthers 5 ..... 5. *Aglaia.*
DD. Anthers 8–12.
E. Disk cup-like ..... 6. *Melia.*
EE. Disk ring-like ..... 7. *Trichilia.*

54. OLACACEÆ.

A. Stamens twice as many as the petals, all fertile. 1. *Ximenia.*
AA. Stamens anther-bearing, 3–5, staminodia 6 or less ..... 2. *Olax.*

55. AQUIFOLIACEÆ.

A. Petals connate at base; ovary 4–5-loculed.... 1. *Ilex.*
AA. Petals free, linear; ovary 3–5-loculed ..... 2. *Nemopanthus.*

56. CYRILLACEÆ.

A. Racemes terminal; stamens 10: caps. winged.. 1. *Cliftonia.*
AA. Racemes lateral; stamens 5: caps. not winged. 2. *Cyrilla.*

57. CELASTRACEÆ.

A. Fr. indehiscent ..... 1. *Elæodendron.*
AA. Fr. a dehiscent caps.
B. Lvs. opposite.
C. Ovules 1–2, in the axis of the locule ..... 2. *Evonymus.*
CC. Ovules 2, in the locules, erect ..... 3. *Pachystima.*
BB. Lvs. alternate.
C. Ovary confluent with the disk.
D. Locules generally 1-ovuled: plants unarmed: fls. solitary, clustered or cymose ..... 4. *Maytenus.*
DD. Locules 2-ovuled: plants often armed: fls. cymose ..... 5. *Gymnosporia.*
CC. Ovary free ..... 6. *Celastrus.*

Other genera treated are Cassine, Catha, and Tripterygium.

58. STACKHOUSIACEÆ.

In cultivation ..... *Stackhousia.*

59. RHAMNACEÆ.

A. Calyx-lobes persistent, the often star-shaped disk joining its tube to the entire surface of the ovary: fr. dry, 3-winged ..... 1. *Gouania.*
AA. Calyx-lobes deciduous.
B. Disk lining the shallow calyx-tube nearly or quite free from the ovary: fr. drupaceous, mostly fleshy and often edible, with a single 1–4-celled stone inclosing as many seeds, or 1-seeded by abortion; seed-coats membranous.
C. Petals 0: endosperm copious, ruminate .. 2. *Reynosia.*
CC. Petals 5.
D. Fr. winged, dry, leathery: plants prickly: lvs. 3-nerved ..... 3. *Paliurus.*
DD. Fr. a fleshy drupe: plants prickly: lvs. 3-nerved ..... 4. *Zizyphus.*
DDD. Fr. a drupe with leathery sarcocarp: plants unarmed: lvs. penninerved .... 5. *Berchemia.*
BB. Disk lining the calyx-tube, or both adherent to ovary: fr. drupaceous or becoming dry.
C. Lvs. very small or wanting, the spines lf.-like ..... 6. *Colletia.*
CC. Lvs. ordinary.
D. Fr. a fleshy drupe free from calyx, containing 2–4 separate nut-like stones .. 7. *Rhamnus.*
DD. Fr. becoming nearly or quite dry, partly inferior, separating into 3 nutlets: ovary adnate to disk at its base ..... 8. *Ceanothus.*
DDD. Fr. a caps. with membranous covering, inferior, separating into 3 cocci, which are dehiscent inside ..... 9. *Pomaderris.*
DDDD. Fr. indehiscent, pea-shaped, 3-celled, 3-seeded: ovary free ..... 10. *Hovenia.*

The genus Rhamnella is sometimes cultivated.

60. VITACEÆ.

A. Stamens free: climbing shrubs or herbs.
B. Petals expanding; fls. in cymes: bark close; pith white.
C. Plants climbing, mostly by adhesion of dilated and disk-shaped tips of the tendril-branches: no distinct disk or free nectariferous glands, but a nectariferous and wholly confluent thickening of the base of the ovary, or even this obsolete: lvs. never pinnate ..... 1. *Parthenocissus.*
CC. Plants climbing by the prehension and coiling of naked-tipped tendrils: nectariferous disk or glands surrounding the ovary or its base, and at least partly free from it.
D. Fls. 5-merous: woody plants, mostly hardy ..... 2. *Ampelopsis.*
DD. Fls. 4-merous: more or less fleshy, woody or herbaceous; mostly tropical or subtropical ..... 3. *Cissus.*
BB. Petals cast off from the base while cohering by their tips; hypogynous disk or 5 nectariferous glands alternate with the stamens; fls. in panicles: berries usually edible: lvs. rarely compound, never pinnate ..... 4. *Vitis.*
AA. Stamens with connate filaments: lvs. 1–3-pinnate: upright trees or shrubs ..... 5. *Leea.*

Tetrastigma is also briefly treated.

61. SABIACEÆ.

In cultivation ..... *Meliosma.*

62. ACERACEÆ.

A. Nutlets winged all around: lvs. pinnate, with 9–15 lfts. ..... 1. *Dipteronia.*
AA. Nutlets with an elongated wing on one side: lvs. simple or compound ..... 2. *Acer.*

63. STAPHYLEACEÆ.

A. Lvs. opposite: several seeds in each cell.
B. Ovary 2–3-parted at base.
C. Caps. vesiculose ..... 1. *Staphylea.*
CC. Follicles coriaceous ..... 2. *Euscaphis.*
BB. Ovary 3-lobed: fr. fleshy or leathery ..... 3. *Turpinia.*
AA. Lvs. alternate: 1 seed in each cell: fr. berry-like ..... 4. *Tapiscia.*

64. MELIANTHACEÆ.

A. Calyx subsaccate, the segms. narrow, very unequal at base: ovules in the locules 2–4 .... 1. *Melianthus.*
AA. Calyx of 5 free, roundish sepals: ovules numerous in 2 series on the placentæ ..... 2. *Greyia.*

65. HIPPOCASTANACEÆ.

In cultivation ..... *Æsculus.*

66. SAPINDACEÆ.

A. Fls. irregular.
B. Ovules solitary in the locules (rarely 2 in Paullinia): plant climbing.
C. Fr. a winged samara ..... 1. *Serjania.*
CC. Fr. bladdery, membranous, loculicidal .... 2. *Cardiospermum.*
CCC. Fr. a pear-shaped, septicidal caps ..... 3. *Paullinia.*
BB. Ovules 2 or more in the locules: plant erect.
C. Sepals valvate; petals 3–4 ..... 4. *Kœlreuteria.*
CC. Sepals imbricate; petals 4–5 ..... 5. *Ungnadia.*
AA. Fls. regular, or nearly so.
B. Stamens inserted at the base of the ovary inside the disk, often unilateral.
C. Fr. dehiscent; ovules 2 or more in cells.
D. Disk produced into 5 horns; fls. in racemes before the lvs., showy ..... 6. *Xanthoceras.*
DD. Disk annular or cup-shaped; fls. usually in panicles.
E. Lvs. ternate: sepals glabrous; disk cupular ..... 7. *Delavaya.*
EE. Lvs. pinnate.
F. Petals 5; sepals imbricate, pubescent ..... 8. *Blighia.*
FF. Petals 0; sepals valvate ..... 9. *Stadmannia.*
CC. Fr. indehiscent.
D. Aril present; fr. edible.
E. Calyx deeply 5-parted, imbricate; petals present ..... 10. *Euphoria.*
EE. Calyx with small valvate lobes or obsoletely toothed; petals 0 ..... 11. *Litchi.*
DD. Aril wanting.
E. Fr. deeply lobed or divided into 3 (–1) cocci: sepals 5: lfts. usually many ..... 12. *Sapindus.*
EE. Fr. not deeply lobed: sepals 4: lfts. 2–4 ..... 13. *Melicocca.*
BB. Stamens inserted outside the disk or disk wanting; petals 0: caps. winged, papery or leathery: lvs. simple or pinnate ..... 14. *Dodonæa.*

Additional genera are somewhat cultivated, as Alectryon, Bersamo, and Diploglottis.

67. ANACARDIACEÆ.

A. Lvs. simple
B. Stamens 5; styles 3 ..... 1. *Semecarpum.*
BB. Stamens 8–10 (all or some fertile); style eccentric; stigma a mere dot ..... 2. *Anacardium.*
BBB. Stamens 1–5; style lateral; stigma simple. 3. *Mangifera.*
AA. Lvs. pinnate or composed of 3 lfts.
B. Ovary 1-celled.
C. Ovules suspended at or near the apex.
D. Styles in the pistillate fls. short, in the staminate fls. 4–5 ..... 4. *Tapiria.*
5. *Cyrtocarpa.*
DD. Styles 3 ..... 6. *Schinus.*
CC. Ovules suspended by a basilar funiculus.
D. Styles 3 ..... 7. *Pistacia.*

DD. Petals 4–6 or more.
E. Stamens in a single whorl.
F. The petals valvate..... 8. *Sorindeia.*
FF. The petals imbricate.
G. Style lateral in fr.; pedicels becoming plumose: lvs. simple... 9. *Cotinus.*
GG. Style terminal in fr.; pedicels not plumose in fr.: lvs. compound, rarely simple.....10. *Rhus.*
EE. Stamens in 2 whorls, the outer alternate with the petals; petals valvate .....11. *Lithræa.*
BB. Ovary 2–5-celled.
C. Fls. polygamous; stamens 8–10; petals subvalvate.....12. *Spondias.*
CC. Fls. dicœcious; stamens 8–9; petals imbricate.....13. *Harpephyllum.*

The genera Coryxocarpus and Smodingium are also described in this Cyclopedia.

68. CORIARIACEÆ.

The only genus..... *Coriaria.*

69. MORINGACEÆ.

The only genus..... *Moringa.*

70. LEGUMINÓSÆ.

I. Summary of Suborders and Tribes.

Ignoring exceptions and six tribes of which no examples appear to be cult. in America. (Other genera of Leguminosæ may be met with now and then in cultivation, but they are so little grown and so many that the introduction of them here would make the key unnecessarily complicated; some of these are mentioned at the end of the Leguminosæ, p. 95.)

Suborder I.—MIMOSEÆ.

A. Fls. regular, small; calyx gamosepalous or valvately parted; petals valvate, often connate, below the middle.
B. Stamens numerous, ∞.
C. The stamens free..... 1. ACACIA TRIBE.
CC. The stamens monadelphous..... 2. INGA TRIBE.
BB. Stamens fewer, definite.
C. Anthers usually appendaged with a stalked gland; stamens twice as many as the petals, rarely as many: fls. generally 5-merous.... 3. ADENANTHERA [TRIBE.
CC. Anthers not glandular; stamens as many as the petals, rarely twice as many: fls. 4–5-merous, rarely 3- or 6-merous..... 4. MIMOSA TRIBE.

AA. Fls. irregular and truly papilionaceous, i. e., like a sweet pea, the standard outside of the other petals and inclosing them in the bud; sepals more or less united above the disk into a tube or cup; radicles inflexed, accumbent or rarely very short and straight. (Compare AAA.)

Suborder II.—PAPILIONEÆ.

B. Lvs. simple, or else digitately compound. (Exceptions: A few members of the Trifolium Tribe are digitately compound and some of the Phaseolus Tribe are subdigitately compound. Some lvs. that appear to be simple have been reduced from several lfts. to 1, generally leaving a gland, joint or other indication of the reduction.)
C. Stamens 10, free: shrubs, rarely herbs..... 5. PODALYRIA TRIBE.
CC. Stamens 10, monadelphous, rarely diadelphous: racemes terminal or opposite the lvs. or the fls. solitary or subfascicled at the axils.. 6. GENISTA TRIBE.
BB. Lvs. pinnate, rarely digitate in the Trifolium Tribe, or subdigitate in the Phaseolus Tribe or the lvs. sometimes reduced to a single lft.
C. Stamens 10, free: lfts. 5 or more, sometimes reduced to 1 large lft., rarely 3..... 7. SOPHORA TRIBE.
CC. Stamens monadelphous or diadelphous.
D. The pod jointed, rarely 1-jointed; 1-seeded by abortion. Otherwise like the Lotus, Galega and Phascolus Tribes. An artificial division..... 8. HEDYSARUM
DD. The pod not jointed. [TRIBE.
E. Pod indehiscent, larger than calyx, membranous, leathery, woody or drupaceous: lfts. 5 or more, rarely 3–1: trees or tall shrubs or climbers..... 9. DALBEROIA
EE. Pod dehiscent or if indehiscent usually of small size, generally 2-valved. [TRIBE.
F. Fls. in heads or umbels, rarely solitary: lfts. 3 or more, entire: alternate filaments usually dilated at the apex: herbs or subshrubs.....10. LOTUS TRIBE.
FF. Fls. solitary or racemose, sometimes panicled or fascicled.
G. Plants typically climbing herbs, raising themselves by means of tendrils at the tips of the petioles: sometimes there is a mere bristle: lfts. often denticulate at apex.....11. VICIA TRIBE.
GG. Plants twining or erect, not climbing by tendrils.
H. Lfts. generally 3.
I. Habit of plants mostly twining.....12. PHASEOLUS
II. Habit of plants [TRIBE.
mostly erect.....13. TRIFOLIUM TRIBE.
HH. Lfts. mostly 5 or more..14. GALEOA TRIBE.

AAA. Fls. more or less irregular, but not truly papilionaceous. When they seem to be so, the petal answering to the standard will be found within the other petals instead of outside as in AA: radicle straight, very rarely slightly oblique.

Suborder III.—CÆSALPINEÆ.

B. Calyx gamosepalous beyond the disk or valvately parted: lvs. simple and entire or 2-lobed, or rarely cut into 2 lfts.: stipe of ovary free or adnate to calyx-tube.....15. BAUBINIA TRIBE.
BB. Calyx usually parted to the very disk and the segms. imbricate.
C. Stipe of ovary adnate to the disk-bearing calyx-tube: lvs. mostly abruptly pinnate.....16. AMBERSTIA TRIBE.
CC. Stipe of ovary free in the bottom of the calyx.
D. Anthers versatile: lvs. mostly bipinnate.....17. CÆSALPINIA TRIBE.
DD. Anthers basifixed, erect but longitudinally dehiscent by 2 pores or short cracks.....18. CASSIA TRIBE.

II. Key to the Tribes.

1. Acacia Tribe.

The only genus..... 1. *Acacia.*

2. Inga Tribe.

A. Lvs. once pinnate..... 2. *Inga.*
AA. Lvs. mostly twice pinnate.
B. Shape of pods circinate, arched or variously twisted.
C. Pod usually 2-valved; seeds generally surrounded by a thin pulp..... 3. *Pithecolobium.*
CC. Pod indehiscent, usually septate between the seeds..... 4. *Enterolobium.*
BB. Shape of pods straight, or at most slightly sickle-shaped.
C. Valves separating from the persistent sutures..... 5. *Lysiloma.*
CC. Valves elastically dehiscent and revolute from apex to base..... 6. *Calliandra.*
CCC. Valves not elastic: pod often indehiscent.. 7. *Albizzia*

3. Adenanthera Tribe.

A. Fls. short-pediceled..... 8. *Adenanthera.*
AA. Fls. sessile.
B. The pod indehiscent (presumably so in Stryphnodendron).

c. Pod straight, thick-compressed, transversely septate inside between the seeds.....9. *Stryphnodendron.*
cc. Pod straight, falcate or variously twisted, thick-compressed or subterete, usually septate inside between the seeds.....10. *Prosopis.*
bb. The pods 2-valved. (See also bbb.)
c. Pod straight or arched, flat; valves entire, continuous within: shrubs or trees.....11. *Piptadenia.*
cc. Pod obliquely oblong, deflexed from the stipe: herbs or diffuse sub-shrubs, prostrate or floating.....12. *Neptunia.*
bbb. The pod flat, with thickened persistent continuous sutures, the valves transversely jointed between the sutures, the joints 1-seeded.....13. *Entada*

4. Mimosa Tribe.

a. Pods provided with a replum, i. e., a frame-like placenta, which remains after the valves have fallen away from it.
b. Valves wider than replum.....14. *Mimosa.*
bb. Valves narrower than the replum or hardly wider.....15. *Schrankia.*
aa. Pods 2-valved in the ordinary fashion.....16. *Leucæna.*

5. Podalyria Tribe.

a. Keel-petals free or slightly connate: foliage herbaceous.
b. Pod linear or oblong-inflated.....17. *Thermopsis.*
bb. Pod globose or ovoid, turgid or inflated.....18. *Baptisia.*
aa. Keel-petals connate on the back: foliage mostly leathery.
b. Ovules 4 or more.
c. Keel about as long as the wings.....19. *Oxylobium.*
cc. Keel much shorter than wings.....20. *Chorizema.*
bb. Ovules 2.
c. Pod indehiscent: calyx shortly 5-toothed..21. *Viminaria.*
cc. Pod 2-valved: calyx 5-fid, or bilabiate.....22. *Pultenæa.*

6. Genista Tribe.

a. Stamens coalesced into a sheath which is split above the middle.
b. Seeds strophiolate.
c. Lvs. simple or reduced to mere scales....23. *Templetonia.*
cc. Lvs. pinnate; lfts. 3.....24 *Goodia.*
bb. Seeds not strophiolate.....25. *Crotalaria.*
aa. Stamens coalesced into a closed tube.
b. Seeds not strophiolate.
c. Calyx-lobes or lips much longer than the tube.....26. *Lupinus.*
cc. Calyx-lobes or -teeth shorter than the tube, rarely somewhat longer.
d. Lfts. 3.
e. Pod stalked.....27. *Laburnum.*
ee. Pod sessile.
f. Claws of petals adnate to staminal tube.....28. *Petteria.*
ff. Claws of petals free.
g. Shrubs unarmed: upper calyx-lobes distinct.....29. *Adenocarpus.*
gg. Shrubs usually spinescent: calyx short, truncate.....30. *Calycotome.*
dd. Lfts. usually all wanting, rarely 3 or 1: shrubs with spiny or rush-like branches.
e. Shrub with rush-like branches.....31. *Spartium.*
ee. Shrubs spiny or unarmed: lfts. reduced to 1 or 0, rarely 3.
f. Fls. yellow; calyx not inflated.....32. *Genista.*
ff. Fls. violet or bluish; calyx inflated: spiny shrub.....33. *Erinacea.*
bb. Seeds strophiolate.
c. Calyx colored, 2-parted; the upper segms. 2-toothed, lower 3-toothed: leafless shrubs, the branchlets and petioles transformed into spines.....34. *Ulex.*
cc. Calyx with the 2 upper lobes or teeth connate or free, the 3 lower connate into a lower lip.....35. *Cytisus.*

7. Sophora Tribe.

a. Fl. with petals all nearly alike.....36. *Cadia.*
aa. Fl. distinctly papilionaceous.
b. Pod 2-valved.....37. *Castanospermum.*
bb. Pod indehiscent or at most tardily dehiscent to a slight extent.
c. The pod moniliform.....38. *Sophora.*
cc. The pod not moniliform, linear.
d. Color of fls. yellow in axillary racemes..39. *Calpurnia.*
dd. Color of fls. white, paniculed.
e. Winter-buds inclosed in the base of the enlarged petiole: panicle loose, drooping.....40. *Cladrastis.*
ee. Winter-buds free: panicle dense, upright.....41. *Maackia.*

8. Hedysarum Tribe.

a. Stamens all free among themselves.....42. *Adesmia.*
aa. Stamens all connate in a closed tube.....43. *Arachis.*
aaa. Stamens nearest the standard free or connate with the others only at the base or at the middle.
b. Filaments all dilated above or only alternate ones.
c. Keel obtuse.....44. *Ornithopus.*
cc. Keel acute or beaked.....45. *Coronilla.*
bb. Filaments normal.
c. Wings short or very short, rarely as long as the keel: lfts. not provided with minute stipules.
d. Pod flat or compressed.
e. Joints many, rarely 2: standard-stamen free.....46. *Hedysarum.*
ee. Joints 2: standard-stamen connate with others at middle.....47. *Onobrychis.*
dd. Pod thickish, subterete.....48. *Alhagi.*
cc. Wings as long as or longer than the keel: partial petioles of lfts. bear minute stipules (except in Lespedeza 0).
d. Pod indehiscent, rarely opening at the lower suture; joints flat.....49. *Desmodium.*
dd. Pod of about 4 small, distinct, 1-seeded, smooth, veined joints included in the calyx.....50. *Uraria.*
ddd. Pod 1-seeded, indehiscent; no joints....51. *Lespedeza.*

9. Dalbergia Tribe.

a. Fr. drupaceous, globose or ovoid, indehiscent, the endocarp woody.....52. *Andira.*
aa. Fr. not drupaceous.
b. Lfts. mostly alternate.
c. Anthers versatile, the locules parallel, longitudinally dehiscent.....53. *Tipuana.*
cc. Anthers small, erect, didymous, the locules placed back to back; generally dehiscent at apex by a short crack.....54. *Dalbergia.*
bb. Lfts. opposite.
c. Pod longitudinally 4-winged.....55. *Piscidia.*
cc. Pod with a narrow wing along the upper suture or both sutures.....56. *Derris.*

10. Lotus Tribe.

a. Pod indehiscent or tardily 2-valved.....57. *Anthyllis.*
aa. Pod 2-valved.
b. Calyx-lobes usually longer than tube; keel rostrate.....58. *Lotus.*
bb. Calyx-teeth shorter than tube; keel obtuse..59. *Hosackia.*

11. Vicia Tribe.

a. St. woody: infl. subterminal; stamens 9, the standard-stamen absent.....60. *Abrus.*
aa. St. herbaceous: fls. solitary or racemose in the axils; stamens 10.
b. Wings adherent to the keel.....61. *Lens.* (See article Lentil.)
bb. Wings free or only slightly adherent.
c. Sheath of stamens oblique at the mouth; style slender, bearded or hairy only at the apex or all around the upper part...62. *Vicia.*
cc. Sheath of stamens equal at the mouth.
d. Calyx-lobes leafy; style rigid, dilated above and the margins reflexed and joined together so that it becomes flattened laterally; bearded down the inner edge.....63. *Pisum.*
dd. Calyx-lobes not leafy; style flattened above on the back and front; bearded down one face.....64. *Lathyrus.*

12. Phaseolus Tribe.

a. Style longitudinally bearded above on the inner side or rarely pilose only around the stigma; petals normal or the keel long-beaked or spiral: infl. nodose-racemose.
b. Calyx-tube not longer than lobe.
c. Keel spiral.....65. *Phaseolus.*
cc. Keel obtuse or arched beaked.
d. Stigma strongly oblique or introrse.....66. *Vigna.*
dd. Stigma subglobose on inner face; style flattened out at apex.....67. *Pachyrhizus.*
ddd. Stigma small, terminal; style filiform or subulate at apex.....68. *Dolichos.*
bb. Calyx-tube cylindrical, longer than lobes....69. *Clitoria.*
aa. Style not bearded.
b. Standard-stamen free only at the very base, thence connate with the rest into a closed tube; calyx mostly 4-lobed.
c. Calyx bell-shaped.
d. Pod broad, the upper suture thickened or 2-winged.....70. *Dioclea.*
dd. Pod linear, narrow or flat.....71. *Pueraria.*

cc. Calyx bilabiate, the upper lip larger, entire or 2-lobed or 2-parted.....72. *Canavalia.*
bb. Standard-stamen free or connate only at the base.
c. Calyx 4-lobed.....73. *Galactia.*
cc. Calyx not 4-lobed.
d. Infl. usually racemose, the rachis of the raceme jointed.
e. Standard much larger than the wings and keel.....74. *Erythrina.*
ee. Standard smaller than the keel.
f. Pod 2-valved.
g. Anthers of 2 kinds.....75. *Mucuna.*
gg. Anthers uniform.....76. *Apios.*
ff. Pod not dehiscent, except at the top.....77. *Butea.*
dd. Infl. sometimes racemose but the rachis of the raceme not jointed.
e. Lvs., especially beneath, with minute resinous dots: infl. racemose or subumbellate or the fls. solitary.
f. Ovules 2.....78. *Flemingia.*
ff. Ovules 4 or more.
g. Pod turgid; seeds strophiolate...79. *Fagelia.*
gg. Pod compressed; seeds not strophiolate.....80. *Cajanus.*
ee. Lvs. without minute resinous dots: fls. clustered or racemose in the axils, solitary or twin along the rachis.
f. Fls. showy; standard large, flattened out; bracts persistent.....81. *Centrosema.*
ff. Fls. medium-sized; standard, erect, complicate, sides often reflexed: bracts persistent.....82. *Amphi-*
fff. Fls. small (showy in Kennedya); standard spreading or reflexed; bracts persistent or small and deciduous. [*carpæa.*
g. Seeds not strophiolate.....83. *Glycine.*
gg. Seeds strophiolate.
h. The fls. small; keel usually much smaller than wings....84. *Harden-*
hh. The fls. showy; keel usually equaling or surpassing the wings.....85. *Kennedya.* [*bergia*

13. Trifolium Tribe.

a. Standard-stamen connate with the others into a closed tube; keel beaked.....86. *Ononis.*
aa. Standard-stamen free; keel obtuse or in Parochetus acutish.
b. Lfts. digitate (rarely pinnate in Trifolium).
c. Pod 2-valved: keel acutish; petals not adnate.....87. *Parochetus*
cc. Pod usually indehiscent: claws of all or the lower petals adnate to the staminal tube.....88. *Trifolium.*
bb. Lfts. 3, pinnate.
c. Pod straight, sickle-shaped or arched, sometimes thick and beaked, sometimes linear, sometimes broad and flat, indehiscent or folliculately gaping or rarely 2-valved.....89. *Trigonella.*
cc. Pod spirally falcate, circinnate or cochleate.....90. *Medicago.*
ccc. Pod small, subglobose or ovoid, thick, indehiscent or tardily 2-valved.....91. *Melilotus.*

14. Galega Tribe.

a. Connective of the anthers appendaged with a small gland or mucro: ovules mostly ∞, 1–2 in a few species; pod 2-valved.....92. *Indigofera.*
aa. Connective not appendaged.
b. Ovules 1–2, rarely 3–4. (See also bb.)
c. Number of ovules 1.....93. *Psoralea.*
cc. Number of ovules 2, rarely 3–4.
d. Stamens 10.....94. *Amorpha.*
dd. Stamens 5.....95. *Petaloste-*
bb. Ovules ∞ (1–2 in a few species of Tephrosia). [*mon.*
c. Infl. terminal or opposite the lvs., mostly racemose (in Galega both axillary and terminal, in some Tephrosias axillary): pod 2-valved.
d. Style longitudinally bearded on the inner side; calyx long-tubular; petals very long-clawed.....96. *Barbieria.*
dd. Style glabrous (or merely penicillate at the stigma in some tephrosias).
e. Standard-stamen connate with the rest from the base.....97. *Galega.*
ee. Standard-stamen free or connate with the others from the middle.
f. The pod narrow or short, with slender valves and nerviform or hardly thickened sutures.....98. *Tephrosia.*
ff. The pod thick, leathery or woody.
g. Pod usually tardily dehiscent: infl. mostly panicled.....99. *Milletia.*
gg. Pod easily dehiscent: infl. racemose.....100. *Wistaria.*
cc. Infl. axillary, except where noted below.
d. Pod flat, except where the seeds finally make it turgid.....101. *Robinia.*
dd. Pod inflated, turgid or terete, longitudinally septate or undivided, rarely flat and when so always longitudinally septate.
e. Stylea variously bearded above
f. Petals acuminate.....102. *Clianthus.*
ff. Petals not acuminate.
g. Standard erect.....103. *Suther-*
gg. Standard spreading or reflexed. [*landia.*
h. Stigma small.....104. *Swainsona.*
hh. Stigma prominent.....105. *Colutea.*
ee. Style not bearded.
f. Lvs. even-pinnate: shrubs or trees.
g. The pod stipitate, obovoid or oblong.....106. *Halimoden-*
[*dron.*
gg. The pod linear, usually acute....107. *Caragana.*
ff. Lvs. odd-pinnate or with a spiny petiole instead of an odd lft.
g. Anther-cells confluent at apex...108. *Glycyrrh-*
gg. Anthers uniform. [*iza.*
h. Petals not all narrow, the standard obovate or orbicular.....109. *Calophaca.*
hh. Petals narrow.
i. Keel blunt.....110. *Astragalus.*
ii. Keel acute.....111. *Oxytropis.*

15. Bauhinia Tribe.

a. Petals erect or spreading, only slightly unequal.....112. *Bauhinia.*
aa. Petals falsely pea-like, the standard inmost....113. *Cercis.*

16. Amherstia Tribe.

a. The petals absent; sepals 4.....114. *Saraca.*
aa. The petals present.
b. Bractlets persistent, inclosing the bud.
c. Petals 5, slightly unequal.....115. *Brownea.*
cc. Petals unequal, 1 very wide, 2 narrow, 2 minute and rudimentary.....116. *Amherstia.*
bb. Bractlets small or deciduous.
c. Lfts. 1 pair.....117. *Hymenæa.*
cc. Lfts. 2 or more pairs.
d. Petals 5, 3 perfect, 2 rudimentary....118. *Tamarin-*
[*dus.*
dd. Petals 5, slightly unequal.....119. *Schotia.*

17. Cæsalpinia Tribe.

a. Calyx-lobes strongly imbricate; disk-bearing tube short: seed not albuminous.
b. Pod indehiscent: stigma peltate.....120. *Peltoph-*
[*orum.*
bb. Pod 2-valved: stigma not peltate.....121. *Cæsalpinia.*
aa. Calyx-tube long, or top-shaped or bell-shaped; segms. short or narrow and open: seeds, when known, albuminous.
b. Pod turgid or subterete.....122. *Gymnoc-*
[*ladus.*
bb. Pod flattish.....123. *Gleditsia.*
aaa. Calyx-segms. valvate.
b. Segms. 4, the upper ones connate; highest petal widest, lowest narrow.....124. *Colvillea.*
bb. Segms. 5; petals roundish, about equal.....125. *Poinciana.*
aaaa. Calyx-segms. slightly imbricate or valvate: seeds albuminous.
b. Ovary adnate to calyx-tube.....126. *Schizolob-*
[*ium.*
bb. Ovary free in bottom of calyx.....127. *Parkin-*
[*sonia.*

18. Cassia Tribe.

a. Petals 5; fls. hermaphrodite.....128. *Cassia.*
aa. Petals 0; fls. polygamous.....129. *Ceratonia.*

The following genera also are described as having more or less horticultural interest: Afzelia, Amicia, Aotus, Baikiæa, Baphia, Brachysema, Camdensia, Carmichælia, Cicer, Copaifera, Dalea, Desmanthus, Dichrostachys, Diphysa, Ebenus, Eutaxia, Galedupa, Gliricidia, Hæmatoxylon, Hippocrepis, Hoffmanseggia, Hovea, Jacksonia, Kerstingiella, Krameria, Lonchocarpus, Minkelersia, Piptanthus, Podalyria, Pterocarpus, Pterolobium, Rhynchosia, Scorpiurus, Sesbania, Toluifera, Vouapa.

71. ROSACEÆ.

I. Summary of Tribes.

A. Ovary inferior; carpels 2–5, more or less connate and adnate to the cup-shaped receptacle, the whole developing into a fleshy fr. (pome): trees or shrubs with free stipules..... 4. POME TRIBE.

AA. Ovary superior.

B. Carpels usually many, if 1 or 2, fr. not drupaceous: calyx persistent.

C. Fr. follicular, dehiscent.

D. Seeds not winged: fls. small.... 1. SPIRÆA TRIBE.

DD. Seeds winged, flattened: fls. rather large..... 2. QUILLAJA TRIBE.

CC. Fr. not follicular, indehiscent, or carpels growing into drupelets.

D. Pistils borne on a flat, hemispherical or convex receptacle, subtended by a cup-shaped portion of the receptacle (hypanthium), usually many.

E. The pistils 2–5: shrubs, with simple lvs.

F. Stipules wanting: fls. small, in large panicles..... 3. HOLODISCUS TRIBE.

FF. Stipules present: fls. solitary or in few-fld. corymbs..... 5. KERRIA TRIBE.

EE. The pistils many (if few, lvs. compound): herbs or shrubs.

F. Carpels becoming dry achenes.

G. Ovules 2; carpels 5–15: calyx without bractlets: herbs..... 9. ULMARIA TRIBE.

GG. Ovules 1: carpels many; calyx usually with bractlets alternating with the lobes..... 6. POTENTILLA [TRIBE.

FF. Carpels becoming drupelets: ovules 2, but seed solitary. 7. RUBUS TRIBE.

DD. Pistils inclosed in the tubular- or urn-shaped receptacle (hypanthium).

E. Number of pistils 1 or 4; petals sometimes wanting.

F. Hypanthium tubular or campanulate, the achenes loosely and usually only partly inclosing; pistils usually 1: shrubs..... 8. CERCOCARPUS [TRIBE.

FF. Hypanthium urceolate, completely inclosing the 1–4 achenes; sepals usually 4: herbs or shrubs.....10. SANGUISORBA [TRIBE.

EE. Number of pistils many; calyx-tube becoming fleshy; petals present: shrubs with odd-pinnate lvs.....11. ROSE TRIBE.

BB. Carpels 1, rarely 2: fr. drupaceous: calyx usually deciduous.

C. Fls. symmetrical; style subterminal: ovules pendulous; radicles superior.....12. PRUNUS TRIBE.

CC. Fls. often unsymmetrical; style basilar: ovules ascending; radicles inferior.....13. CHRYSOBALANUS [TRIBE.

II. Key to the Tribes.

1. Spiræa Tribe.

A. Pistils opposite to the petals or less than 5.

B. Lvs. simple, often lobed, rarely pinnatifid: stamens inserted on the margin of the hypanthium: shrubs, rarely undershrubs.

C. Stipules large, caducous: staminal disk wanting: seeds shining, crustaceous.

D. Follicles dehiscent along both sutures, often inflated, 1–5: fls. in terminal corymbs..... 1. *Physocarpus.*

DD. Follicles dehiscent only along the ventral suture, 1–2, not inflated.

E. Fls. in terminal panicles; style terminal; pistils, 2, rarely 1: follicles usually 5-seeded..... 2. *Neillia.*

EE. Fls. in small terminal corymbs; style lateral; pistil 1: follicles 1-or rarely 2-seeded..... 3. *Stephanandra.*

CC. Stipules wanting: staminal disk usually present: seeds dull.

D. The lvs. entire, serrate or lobed: stamens free.

E. Carpels free.

F. Fls. in panicles, corymbs or umbel-like racemes; carpels dehiscent along the ventral suture: lvs. usually serrate or lobed..... 4. *Spiræa.*

FF. Fls. in racemes; carpels dehiscent on both sutures: lvs. entire, evergreen: cespitose undershrub. 5. *Petrophytum.*

EE. Carpels connate at the base; fls. polygamo-dicœcious, in panicles: lvs. entire, deciduous: upright shrub... 6. *Sibiræa*

DD. The lvs. twice trifid: stamens connate at the base: fls. in racemes: prostrate undershrub..... 7. *Luetkea.*

BB. Lvs. 2–3-pinnate: fls. dicœcious, in ample panicles composed of slender spikes: herbs..... 8. *Aruncus.*

AA. Pistils opposite to the sepals, 5.

B. Petals roundish, imbricate in the bud; carpels connate at the base: lvs. pinnate or bipinnate: shrubs.

C. Lvs. pinnate; lfts. coarsely serrate ..... 9. *Sorbaria.*

CC. Lvs. bipinnate; segms. minute, entire....10. *Chamæbatiaria.*

BB. Petals strap-shaped, convolute in the bud: carpels distinct: lvs. ternate: herba.....11. *Gillenia.*

2. Quillaja Tribe.

A. Carpels free, spreading, star-like at maturity: evergreen trees.

B. Stamens 10.....12. *Quillaja.*

BB. Stamens 20.....13. *Kageneckia.*

AA. Carpels connate into a 5-celled caps.: stamens 15–20: deciduous shrub.....14. *Exochorda.*

3. Holodiscus Tribe.

Lvs. doubly serrate or slightly lobed .....15. *Holodiscus.*

4. Pome Tribe.

A. Carpels bony at maturity: fr. hence with 1–5 stones.

B. Pistils with 2 fertile ovules: lvs. entire or crenate.

C. Lvs. entire: spineless shrubs: styles 2–5...16. *Cotoneaster.*

CC. Lvs. crenate, persistent: usually spiny shrubs: styles 5.....17. *Pyracantha.*

BB. Pistils with only 1 fertile ovule: lvs. usually doubly serrate or lobed.

C. Ovules 2, 1 fertile and 1 sterile: lvs. simple, often pinnately lobed.

D. Number of carpels 5, wholly connate and covered at the top by the flesh of the fr.: fls. solitary, 2 in. across: lvs. entire or occasionally dentate.....18. *Mespilus.*

DD. Number of carpels 1–5, more or less distinct at the ventral suture and free at the top: fls. 1 in. or less across, usually in corymbs: lvs. often lobed... .....19. *Cratægus.*

CC. Ovule but 1; stones 5: lvs. pinnate (the simple-lvd. species belong to Hesperomeles, which is not in cult.).....20. *Osteomeles.*

AA. Carpels with leathery or papery walls at maturity: fr. hence 1–5-celled, each cell with 1 or 2, rarely many seeds.

B. Fls. in compound corymbs.

C. Styles 1–5, distinct or connate; carpels partly free.

D. Fr. solid and pointed at the top; walls of cells leathery: lvs. deciduous, simple or pinnate.

E. Sepals deciduous: lvs. always simple, serrate with excurrent veins: styles 2–3.....21. *Micromeles.*

EE. Sepals persistent.

F. Number of styles usually 2, rarely 3 or 5, free or connate: lvs. pinnate or simple and serrate or lobed with excurrent veins, deciduous.....22. *Sorbus.*

FF. Number of styles 3–5: lvs. serrate to crenulate, with curving veins.

G. Lvs. deciduous, with glands on the midrib above: styles 5, connate below: endocarp thin.23. *Aronia.*

GG. Lvs. evergreen, without glands on the midrib: styles 3–5: endocarp firm.....24. *Stranvæsia.*

DD. Fr. hollow and rounded at the top, small, 1- or 2-seeded; walls usually papery: styles usually 2: lvs. simple, deciduous or evergreen with curving veins.....25. *Photinia.*

CC. Styles 5, distinct; carpels wholly connate: fr. pear-shaped, rather large, yellow: lvs. evergreen with excurrent veins.....26. *Eriobotrya.*

BB. Fls. in umbels, racemes or solitary.

C. The carpels 4- to many-seeded.

D. Styles free: lvs. entire.....27. *Cydonia.*

DD. Styles connate at the base: lvs. serrate or serrulate.

E. Ovules many in each cell: calyx glabrous outside.....28. *Chænomeles.*

EE. Ovules 4–5 in each cell; calyx densely tomentose outside.....29. *Docynia.*

CC. The carpels 1–2-seeded.

DD. Cells of the ovary as many as styles, each with 2 ovules.
E. Ovary 2-celled: fr. 1–2-seeded, black: fls. in upright racemes, sometimes paniceled: lvs. evergreen. 30. *Raphiolepis.*
EE. Ovary 3–5-celled: fls. in umbels: lvs. deciduous. 31. *Pyrus.*
DD. Cells of the ovary twice as many as styles, each with 1 ovule.
E. Styles usually 5; fls. in racemes: lvs. serrate, or crenate at the apex. 32. *Amelanchier.*
EE. Styles 2–3; fls. in few-fld. umbels; calyx-tube cylindric: lvs. entire or denticulate, narrow. 33. *Peraphyllum.*

5. Kerria Tribe.

A. Petals wanting; fls. in few-fld. corymbs: achenes 2–5, drupaceous. 34. *Neviusa.*
AA. Petals present; fls. solitary, large.
B. Lvs. alternate: fls. 5-merous, yellow: achenes drupaceous, yellow. 35. *Kerria.*
BB. Lvs. opposite: fls. 4-merous, white: achenes dry, black. 36. *Rhodotypus.*

6. Potentilla Tribe.

A. Style deciduous.
B. Receptacle in fr. much enlarged, colored.
C. Fls. white: receptacle pulpy, juicy. 37. *Fragaria.*
CC. Fls. yellow: receptacle dry. 38. *Duchesnea.*
BB. Receptacle not fleshy, even in fr.
C. Pistils only 1–12.
D. Stamens 5; petals minute. 39. *Sibbaldia.*
DD. Stamens numerous; petals conspicuous. 40. *Waldsteinia.*
CC. Pistils very numerous.
D. Petals white or yellow, obtuse or emarginate. 41. *Potentilla.*
DD. Petals purple, abruptly acuminate, much smaller than calyx. 42. *Comarum.*
AA. Style elongated after anthesis, often plumose.
B. Fls. 5-merous: lvs. pinnate or pinnatifid.
C. Sepals valvate; hypanthium flat: herbs. 43. *Geum.*
CC. Sepals imbricate; hypanthium concave: shrubs.
D. Calyx with bracts outside. 44. *Fallugia.*
DD. Calyx without bracts. 45. *Cowania.*
BB. Fls. 8–9-merous: lvs. undivided: prostrate undershrub. 46. *Dryas.*

7. Rubus Tribe.

A. Drupelets pulpy. 47. *Rubus.*
AA. Drupelets nearly dry, inclosed by calyx. 48. *Dalibarda.*

8. Cercocarpus Tribe.

A. Fls. apetalous; style elongated and plumose in fr.; hypanthium tubular. 49. *Cercocarpus.*
AA. Fls. with petals.
B. Style with terminal stigma: lvs. linear, needle-shaped. 50. *Adenostoma.*
BB. Style with decurrent stigma.
C. Lvs. 3-fid at the apex: sepals imbricate: fr. inclosed about half. 51. *Purshia.*
CC. Lvs. bipinnate: sepals valvate: fr. inclosed. 52. *Chamæbatia.*

9. Ulmaria Tribe.

Herbs with large pinnate lvs. and large stipules and small white or pink fls. in large panicles. 53. *Filipendula.*

10. Sanguisorba Tribe.

A. Calyx with 5–6 bractlets or 10–12-cut in 2 series or in Agrimonia with a setose limb.
B. Petals 0. 54. *Alchemilla.*
BB. Petals 4 or 5. 55. *Agrimonia.*
AA. Calyx without bractlets; petals 0: lvs. pinnate.
B. Fls. axillary, solitary. 56. *Margyricarpus.*
BB. Fls. spicate or capitate.
C. The calyx valvate; stamens 1–10, short; carpels 1–2. 57. *Acæna.*
CC. The calyx imbricate.
D. Fr. rarely rugose: fls. usually bisexual; carpel 1; stamens 4–12. 58. *Sanguisorba.*
DD. Fr. often rugose: fls. polygamo-dicecious, rarely bisexual; carpels 2; stamens ∞. 59. *Poterium.*

11. Rose Tribe.

The only genus. 60. *Rosa.*

12. Prunus Tribe.

A. Sepals usually 10, small; petals often wanting or small; carpels in the staminate fl. 2, 1 in the fertile fl. 61. *Maddenia.*
AA. Sepals 5.
B. Carpels solitary.
C. Style terminal: lvs. usually serrate: pith of branches solid. 62. *Prunus.*
CC. Style lateral: lvs. entire: pith lamellate. 63. *Prinsepia.*
BB. Carpels 5: lvs. entire. 64. *Osmaronia.*

13. Chrysobalanus Tribe.

Anthers small, short, didymous; ovary 1-loculed, inserted in the base of the calyx-tube; stamens 15 or more. 65. *Chrysobalanus.*

The genus Plagiospermum is also cultivated.

72. SAXIFRAGACEÆ.

I. Summary of Tribes.

A. Plants are trees or shrubs.
B. Lvs. opposite. 1. HYDRANGEA TRIBE.
BB. Lvs. alternate.
C. Stipules absent: lvs. often coriaceous or glandular-serrate: stamens usually isomerous with petals. 2. ESCALLONIA TRIBE.
CC. Stipules absent or adnate to petiole at base: fls. generally racemose; ovary 1-locular, 2-merous; seeds immersed in pulp. 3. RIBES TRIBE.
AA. Plants are herbs.
B. Fls. 4-merous. 4. FRANCOA TRIBE.
BB. Fls. generally 5-merous. 5. SAXIFRAGE TRIBE.

II. Key to the Tribes.

1. Hydrangea Tribe.

A. Ovary superior.
B. Number of petals 4; stamens 10; filaments 2-lobed; styles 3. 1. *Fendlera.*
BB. Number of petals 5 or 6.
C. Ovules solitary: stamens 4–12; styles 3–5. 2. *Whipplea.*
CC. Ovules 4: stamens 15; carpels 2, separate. 3. *Lyonothamnus.*
CCC. Ovules numerous.
D. Petals 5, convolute: stamens 10; styles 3–5. 4. *Jamesia.*
DD. Petals 5 or 6, imbricate: stamens numerous; style 1, with a 5–7-lobed stigma. 5. *Carpenteria.*
AA. Ovary inferior or semi-superior.
B. Stamens 8, 10 or 12.
C. Petals induplicate or imbricate: fr. capsular. 6. *Deutzia.*
CC. Petals valvate.
D. Fr. a caps.
E. Styles 4 or 5, free or connate at the base; petals 4 or 5. 7. *Hydrangea.*
EE. Style 1, with a 4–5-lobed stigma; petals 5. 8. *Schizophragma.*
DD. Fr. a berry: petals 5 or 6: styles 3–5, club-shaped. 9. *Dichroa.*
BB. Stamens ∞.
C. Petals induplicate, 7–10; style 1. 10. *Decumaria.*
CC. Petals imbricate; styles 1–5. 11. *Philadelphus.*
CCC. Petals valvate.
D. Styles 2; petals 4. 12. *Platycrater.*
DD. Styles 3; petals 5. 13. *Cardiandra.*

2. Escallonia Tribe.

A. Petals imbricate; style 1; ovary 2- or 3-loculed. 14. *Escallonia.*
AA. Petals valvate; styles divisible into 2; ovary 2-loculed. 15. *Itea.*

3. Ribes Tribe.

The only genus. 16. *Ribes.*

4. Francoa Tribe.

Sepals and petals equal. 17. *Francoa.*

5. Saxifrage Tribe.

A. Ovary 1-loculed.
B. Placentæ basilar or nearly so. 18. *Tiarella.*
BB. Placentæ parietal, opposite the stigmas. 19. *Parnassia.*
BBB. Placentæ parietal, alternate with stigmas.
C. Stamens 3; petals 5, capillary. 20. *Tolmiea.*
CC. Stamens 5–10.
D. Caps. not beaked, superior: petals 5, 3-cut or pinnatifid. 21. *Mitella.*
DD. Caps. 2-beaked.
E. Number of stamens 5; petals 5 or 0: caps. inferior. 22. *Heuchera.*

EE. Number of stamens 8 or 10: caps. semi-superior.
F. Petals 0; stamens 8 or 10; fls. solitary ... 23. *Chrysosplenium.*
FF. Petals entire or lobed; stamens 10; fls. racemose ... 24. *Tellima.*
AA. Ovary 2- or 3-loculed, the placentæ in the axis of the fr.; rarely composed of distinct carpels.
B. Stamens 5. (See also BB.)
C. Carpels united at base, adnate to hypanthium ... 25. *Sullivantia.*
CC. Carpels united and wholly adnate to hypanthium ... 26. *Suksdorfia.*
CCC. Carpels 2, united at base, free from but included in the inflated hypanthium ... 27. *Bolandra.*
BB. Stamens 10, rarely 8 (sometimes 5 in Boykinia).
C. Sepals valvate.
D. Petals 0 ... 28. *Rodgersia.*
DD. Petals 5, deciduous; stamens 5 or 10 ... 29. *Boykinia.*
CC. Sepals imbricate.
D. Styles erect; petals 5 or 0; stamens 8 or 10 ... 30. *Astilbe.*
DD. Styles mostly recurved in fr.; petals 5 ... 31. *Saxifraga.*

The following genera also are treated: Abrophyllum, Anopterus, Bauera, Deinanthe, Leptarrhena, and Tanakæa.

73. CUNONIACEÆ.

A. Calyx valvate.
B. Stamens hypogynous, very long ... 1. *Acrophyllum.*
BB. Stamens perigynous ... 2. *Ceratopetalum.*
AA. Calyx imbricate, the lobes very short ... 3. *Cunonia.*

74. CEPHALOTACEÆ.

The only genus ... *Cephalotus.*

75. CRASSULACEÆ.

A. Stamens usually as many as the petals.
B. Petals free or connate only at the base; floral parts in 5's ... 1. *Crassula.*
BB. Petals usually connate to the middle or beyond.
C. Calyx bell-shaped, as long as the corolla-tube ... 2. *Grammanthes.*
CC. Calyx many times shorter than the corolla-tube ... 3. *Rochea.*
AA. Stamens usually twice as many as the petals.
B. Petals free or connate only at the very base.
C. Fls. usually 4–5-merous ... 4. *Sedum.*
CC. Fls. 6-merous or more ... 5. *Sempervivum.*
BB Petals usually connate to the middle or beyond.
C. Calyx large, inflated shortly 4-fid ... 6. *Bryophyllum.*
CC. Calyx 4-parted ... 7. *Kalanchoë.*
CCC. Calyx 5-parted ... 8. *Cotyledon.*

The following are also described: Altamiranoa, Dudleya, Echeveria, Kitchingia, Lenophyllum, Oliveranthus, Pachyphytum, Stylophyllum, Tillæa, and Urbinia.

76. DROSERACEÆ.

A. Stamens 4–8; styles 2–5; placentæ parietal ... 1. *Drosera.*
AA. Stamens about 15; style columnar; placentæ basal ... 2. *Dionæa.*
AAA. Stamens 10–20; styles 5, filiform ... 3. *Drosophyllum.*

77. HAMAMELIDACEÆ.

A. Ovary-locules 1-ovuled.
B. Petals 0.
C. Lvs. evergreen.
D. Stamens 2–8, with long filaments; fls. in racemes ... 1. *Distylium.*
DD. Stamens ∞, with short filaments; fls. in heads; calyx-tube in the pistillate fl. tubular ... 2. *Sycopsis.*
CC. Lvs. deciduous.
D. Number of stamens about 24; fls. in dense spikes ... 3. *Fothergilla.*
DD. Number of stamens 5–7.
E. Calyx-tube not urn-shaped; sepals and stamens 5–7; fls. in short head-like racemes ... 4. *Parrotia.*
EE. Calyx-tube urn-shaped, much longer than ovary; sepals and stamens 5; fls. in long and slender racemes ... 5. *Sinowilsonia.*
BB. Petals as many as calyx-lobes.
C. Fls. borne in catkins, 5-merous.
D. Shape of petals broad; stamens with long-filament; disk present ... 6. *Corylopsis.*
DD. Shape of petals subulate, as long as sepals; stamens nearly sessile; disk 0 ... 7. *Fortunearia.*
CC. Fls. in clusters, 4-merous.
D. Lvs. deciduous, crenate: anthers obtuse, the locules opening with 1 valve ... 8. *Hamamelis.*
DD. Lvs. persistent, entire: anthers beaked, the locules opening with 2 valves ... 9. *Loropetalum.*
AA. Ovary-locules 2- or more-ovuled.
B. Fls. unisexual ... 10. *Liquidambar.*
BB. Fls. bisexual.
C. The fls. 5, in a head, surrounded by an involucre of which the outer bracts are small, the inner gradually larger ... 11. *Rhodoleia.*
CC. The fls. 2 together with very short bracts at the base ... 12. *Disanthus.*

78. BRUNIACEÆ.

In cultivation ... *Audouinia.*
(See article Diosma.)

79. HALORAGIDACEÆ.

A. Stamens 1–2; calyx 3–4-lobed; ovary 1-loculed ... 1. *Gunnera.*
AA. Stamens 2–8; calyx truncate or 4-toothed; ovary deeply 2- or 4-grooved ... 2. *Myriophyllum.*
AAA. Stamen 1; calyx truncate; ovary 1-loculed ... 3. *Hippuris.*

80. RHIZOPHORACEÆ.

A. Anthers 8, subsessile ... 1. *Rhizophora.*
AA. Anthers 15–30, on filaments ... 2. *Cassipourea.*

81. COMBRETACEÆ.

A. Petals 0; calyx-tube not produced beyond ovary ... 1. *Terminalia.*
AA. Petals 5 (0 in a few species of Combretum).
B. Calyx-tube straight, constricted above ovary.
C. Cotyledons convolute ... 2. *Poivrea.*
CC. Cotyledons deeply furrowed or twisted and plaited ... 3. *Combretum.*
BB. Calyx-tube produced to a great length beyond the ovary ... 4. *Quisqualis.*

82. MYRTACEÆ.

A. Ovary 1-loculed ... 1. *Thryptomene.*
AA. Ovary 2- or more-loculed.
B. Fr. a caps., which is loculicidally dehiscent at apex, rarely 1–2-seeded and subindehiscent.
C. Anthers basifixed ... 2. *Calothamnus.*
CC. Anthers versatile.
D. Individual fls. pedicelled.
E. Stamens 5-adelphous ... 3. *Tristania.*
EE. Stamens free.
F. Fls. in globose heads ... 4. *Syncarpia.*
FF. Fls. in forking cymes ... 5. *Metrosideros.*
DD. Individual fls. not pedicelled.
E. Fls. solitary in the axils of the floral lvs. or bracts.
F. Stamens distinct, not longer than petals ... 6. *Leptospermum.*
FF. Stamens distinct, long-exserted ... 7. *Callistemon.*
FFF. Stamens united in clusters, long-exserted ... 8. *Melaleuca.*
EE. Fls. in cymose or umbellate heads.
F. Petals distinct ... 9. *Angophora.*
FF. Petals wanting (or adnate to the calyx-lid) ... 10. *Eucalyptus.*
BB. Fr. a berry or rarely an indehiscent drupe: lvs. opposite, punctate.
C. Stamens straightish in the bud: seeds with endosperm ... 11. *Feijoa.*
CC. Stamens inflexed or involute in the bud: seeds without endosperm.
D. Calyx-limb closed in bud, deeply divided in anthesis ... 12. *Psidium.*
DD. Calyx 4–5-lobed or -parted in the bud, not cut deeper in antheses.

E. Ovules pendulous.....13. *Pimenta.*
EE. Ovules not pendulous.
F. Embryo thick and fleshy.....14. *Eugenia.*
FF. Embryo curved, circular or spiral.
G. The ovary 2–3- rarely 4-loculed: ovules in each locule ∞.....15. *Myrtus.*
GG. The ovary several-loculed by false septa; each ultimate locule 1-ovuled.....16. *Rhodomyrtus.*

Other genera treated incidentally are: Backhousia, Barringtonia, Beaufortia, Blepharocalyx, and Kunzea.

83. LECYTHIDACEÆ.

A. Fr. woody: calyx mostly imbricate.
B. The fr. large and spherical, not opening.... 1. *Couroupita.*
BB. The fr. opening by a lid.
C. Style elongated..... 2. *Bertholletia.*
CC. Style short..... 3. *Lecythis.*
AA. Fr. fibrous: calyx subvalvate or imbricate.
B. Petals 6–8..... 4. *Japarandiba.*
BB. Petals 4 (rarely 5)..... 5. *Barringtonia.*
AAA. Fr. fleshy: calyx mostly valvate or entire.
B. Ovary 4-loculed..... 6. *Grias.*
BB. Ovary 5-loculed..... 7. *Napoleona.*

84. MELASTOMACEÆ.

I. Summary of Tribes.

Excluding five tribes not represented in this work, and following Cogniaux in D. C. Monog. Phaner. vol. 7 (1891).

A. Fr. capsular (rupturing regularly in Melastoma): stamens usually unequal.
B. Caps. and ovary 3–5-angled or winged, much dilated and hollowed out at apex.
C. Ovary-cells as many as petals..... 1. SONERILA TRIBE.
CC. Ovary 3-loculed: petals 5, rarely 4. 2. BERTOLONIA TRIBE.
BB. Caps. and ovary terete or angular, convex or conical at the top.
C. Connective rarely produced below the locules, usually with posterior spur or appendage..... 3. RHEXIA TRIBE.
CC. Connective usually elongated at the base, produced beyond the insertion of the filament into an appendage or wing on the anterior side.
D. Seeds shaped like a snail-shell.
E. Ovary generally partly or wholly inferior: sepals usually alternating with long, stellate hairs..... 4. OSBECKIA TRIBE.
EE. Ovary generally superior; no stellate hairs..... 5. TIBOUCHINA TRIBE.
DD. Seeds oblong or ovoid..... 6. MICROLICIA TRIBE.
AA. Fr. berry-like or leathery, rupturing irregularly: stamens generally equal.
B. Lvs. not finely striate between the primary nerves.
C. Connective usually appendaged or spurred on the posterior side.... 7. DISOCHÆTA TRIBE.
CC. Connective rarely produced at the base, usually not appendaged... 8. MICONIA TRIBE.
BB. Lvs. finely striate between primary nerves with very numerous transverse nervelets..... 9. BLAKEA TRIBE.

II. Key to the Tribes.

1. Sonerila Tribe.

A. Fls. 5-merous; stamens equal; connective with a posterior spur but no anterior appendage... 1. *Gravesia.*
AA. Fls. mostly 3-merous; stamens unequal, those opposite petals smaller..... 2. *Sonerila.*
AAA. Fls. mostly 4-merous; stamens equal; connective not produced..... 3. *Phyllagathis.*

2. Bertolonia Tribe.

A. The connective not appendaged on the anterior side.
B. Connective tuberculate on the posterior side at the base..... 4. *Bertolonia.*
BB. Connective with a short posterior spur and a long ascending appendage..... 5. *Salpinga.*
AA. The connective with a spur on the anterior side and a tubercle on the posterior side..... 6. *Monolena.*

3. Rhexia Tribe.

Stamens equal or subequal: ovary glabrous..... 7. *Rhexia.*

4. Osbeckia Tribe.

Stamens unequal; connective of the larger ones long-produced at base: fr. baccate: fls. not involucrate..... 8. *Melastoma.*

5. Tibouchina Tribe.

A. Stamens unequal: ovary 2–4-celled, usually glabrous; petals not acute; connective of larger stamens with a long, club-shaped, 2-fid appendage..... 9. *Heeria.*
AA. Stamens equal: ovary setose at apex; connective with 2 lobes or tubercles on the anterior side, and no posterior appendage.....10. *Tibouchina.*

6. Microlicia Tribe.

Stamens unequal; anthers short, not beaked; calyx-lobes shorter than tube.....11. *Centradenia.*

7. Dissochæta Tribe.

Stamens equal or nearly so; fls. mostly 4–5-merous.....12. *Medinilla.*

8. Miconia Tribe.

A. Infl. terminal.
B. Lvs. provided with 2-lobed bladders at base.13. *Tococa.*
BB. Lvs. not provided with bladders: outer calyx-lobes none or inconspicuous.....14. *Tamonea.*
AA. Infl. lateral or axillary; petals obtuse; connective not produced at base.....15. *Clidemia.*

9. Blakea Tribe.

The plants described as Amaraboya are now referred to the genus Blakea.....16. *Blakea.*

Calvoa, Dissotis, Kendrickia, and Osbeckia are also cultivated.

85. LYTHRACEÆ.

A. Hypanthium tubular, curved or gibbous at base..... 1. *Cuphea.*
AA. Hypanthium straight.
B. Caps. and ovary all included in hypanthium.
C. Petals 5, rarely 4; stamens 8–10..... 2. *Decodon.*
CC. Petals 6; stamens mostly 6 or 12..... 3. *Lythrum.*
BB. Caps. not all included in hypanthium.
C. The sepals 4; petals 4; stamens 8..... 4. *Lawsonia.*
CC. The sepals 6; petals 6; stamens numerous. 5. *Lagerstræmia.*

86. PUNICACEÆ.

The only genus..... *Punica.*

87. ONAGRACEÆ.

A. Ovary 1–4-celled; cells 1-ovuled, rarely 2–4-ovuled: fr. nut-like, 1–4-celled, 1–4-seeded.
B. Fls. 2-merous; ovary 1–2-celled..... 1. *Circæa.*
BB. Fls. 3–4-merous; ovary 4-celled, rarely 3-celled..... 2. *Gaura.*
AA. Ovary 2–6-celled; cells many-ovuled: fr. a caps. (in Fuchsia a berry).
B. Stamens 1 or 2..... 3. *Lopezia.*
BB. Stamens 4–8, rarely 3.
C. Seeds bearded.
D. Hypanthium broadened out above ovary into a funnel-shaped tube.... 4. *Zauschneria.*
DD. Hypanthium hardly produced beyond ovary..... 5. *Epilobium.*
CC. Seeds not bearded or winged.
D. Hypanthium usually long-produced beyond ovary (except in some Œnotheras).
E. Number of stamens 4..... 6. *Eucharidium*
EE. Number of stamens 8..
F. Fr. a caps..... 7. *Œnothera.*
FF. Fr. a berry..... 8. *Fuchsia.*
DD. Hypanthium not or hardly produced beyond ovary.
E. Caps. loculicidal..... 9. *Clarkia.*
EE. Caps. septicidal.
F. Stamens 8–12.....10. *Jussieua.*
FF. Stamens 3–6.....11. *Ludwigia.*

88. TRAPACEÆ.

The only genus..... *Trapa.*

89. LOASACEÆ.

A. Petals hooded.
B. Caps. 3–5-valved at apex, rarely twisted.... 1. *Loasa.*
BB. Caps. longitudinally 5-10-valved, usually twisted spirally.... 2. *Blumenbachia.*
BBB. Caps. narrow, straight, longitudinally 5-valved.... 3. *Scyphanthus.*
AA. Petals not hooded.
B. Seeds very numerous, arranged in many series.... 4. *Eucnide.*
BB. Seeds few or, if numerous, arranged in 2 series.... 5. *Mentzelia.*

90. PASSIFLORACEÆ.

A. Hypanthium long; petals and stamens 5.... 1. *Tacsonia.*
AA. Hypanthium short; petals 4–5, rarely 0; stamens 4–5.... 2. *Passiflora.*
AAA. Hypanthium medium or short; fls. unisexual. 3. *Modecca.*

91. CARICACEÆ.

In cultivation.... *Carica.*

92. CUCURBITACEÆ.

I. Summary of Tribes.

A. Series 1. Ovules horizontal.... 1. CUCURBITA TRIBE.
AA. Series 2. Ovules erect or ascending, rarely horizontal
B. Fr. ruptures elastically.... 2. CYCLANTHERA TRIBE.
BB. Fr. does not rupture elastically.... 3. ABOBRA TRIBE.
AAA. Series 3. Ovules pendulous.... 4. SICYOS TRIBE.

II. Key to the Tribes.

1. Cucurbita Tribe.

A. Anther-cells straight, rarely curved, not flexuous.... 1. *Melothria.*
AA. Anther-cells flexuous or conduplicate.
B. Corolla bell-shaped, 5-lobed to the middle or a little below.
C. Anthers free.... 2. *Sicana.*
CC. Anthers coherent.
D. Filaments connate.... 3. *Coccinia.*
DD. Filaments free.... 4. *Cucurbita.*
BB. Corolla rotate and 5-petaled or bell-shaped and 5-parted to the base.
C. Petals fimbriate or tendril-bearing.
D. Seeds large, fibrous.... 5. *Telfairea.*
DD. Seeds small, not fibrous.... 6. *Trichosanthes.*
CC. Petals entire.
D. Hypanthium of male fls. long; anthers coherent in an oblong head, usually included.
E. Pistillodes in male fls. 1–3, subulate or setiform.... 7. *Gymnopetalum.*
EE. Pistillode absent or reduced to a gland
F. Anthers coherent.... 8. *Peponia.*
FF. Anthers free.... 9. *Lagenaria.*
DD. Hypanthium of male fls. short; anthers free or slightly coherent, usually exserted.
E. Stamens inserted in the mouth of the hypanthium.
F. Scales in bottom of hypanthium.. 10. *Thladiantha.*
FF. Scales in bottom of hypanthium 2–3,.... 11. *Momordica.*
EE. Stamens inserted in hypanthium.
F. Male fls. in racemes.
G. Fr. dry, fibrous, dehiscent by lid at top.... 12. *Luffa.*
GG. Fr. fleshy, not fibrous.
H. Female fls. solitary.... 13. *Ecballium.*
HH. Female fls. racemose or clustered.... 14. *Bryonia.*
FF. Male fls. solitary or fascicled.
G. Sepals somewhat leafy, serrate, reflexed.... 15. *Benincasa.*
GG. Sepals awl-shaped, entire, erect.
H. Pollen minutely muricate; pistillode 0.... 16. *Bryonopsis.*
HH. Pollen smooth; pistillode reduced to a small gland.
I. Tendrils not branched: connective usually produced upward beyond locule... 17. *Cucumis.*
II. Tendrils 2–3-fid: connective not produced.... 18. *Citrullus.*

2. Cyclanthera Tribe.

A. Fr. oblique, gibbous, rupturing elastically.... 19. *Cyclanthera.*
AA. Fr. not gibbous, opening by 1 or 2 pores at the top or by irregular rupture.... 20. *Echinocystis.* (Incl. Megarrhiza.)

3. Abobra Tribe.

Anther-cells flexuous; stamens free.... 21. *Abobra.*

4. Sicyos Tribe.

Fls. 5-merous, monœcious: fr. fleshy.... 22. *Sechium.*

The genera Actinostemma, Gurania, Herpetospermum, Hodgsonia and Sicyos are sometimes cultivated.

93. BEGONIACEÆ.

A. Ovary wholly inferior.
B. Petals all free.... 1. *Begonia.*
BB. Petals of pistillate fl. grown together.... 2. *Symbegonia.*
AA. Ovary partly superior.... 3. *Hillebrandia.*

94. CACTACEÆ.

A. Fl.-tube wanting.
B. Lvs. large and persistent.
C. Seeds black and shining.... 1. *Pereskia.*
CC. Seeds white, dull and covered with hairs. 2. *Pereskiopsis.*
BB. Lvs. wanting or minute and caducous.
C. Plant epiphytic, spineless: fls. small.
D. Flowering joints bottle-shaped.... 3. *Hariota.*
DD. Flowering joints not bottle-shaped.... 4. *Rhipsalis.*
CC. Plant not epiphytic, usually very spiny: fls. large.
D. Petals spreading; filaments much shorter than the petals.... 5. *Opuntia.*
DD. Petals erect and closely surrounding the stamens; filaments longer than the petals.... 6. *Nopalea.*
AA. Fl.-tube present, often much elongated.
B. Plants epiphytic or nearly so, either flat or 3-angled, usually spineless and always with spineless fr.
C. Sts. 3-angled, bearing small spines at the areoles: ovary and fr. bearing large bracts.... 7. *Hylocereus.*
CC. Sts. normally flat, spineless: ovary and fr. bearing only minute bracts.
D. The sts. weak, divided into many short joints.
E. Fls. irregular.... 8. *Zygocactus.*
EE. Fls. regular.... 9. *Schlumbergera.*
DD. The sts. stouter than the last, with elongated joints.
E. Fl.-tube very short or nearly wanting. 10. *Disocactus.*
EE. Fl.-tube very definite, often much elongated.
F. Fls. small, diurnal.... 11. *Wittia.*
FF. Fls. large, nocturnal.... 12. *Epiphyllum.*
BB. Plants not epiphytic, never flat, with several to many ribs.
C. Sts. globular or cylindrical, not jointed.
D. Plant-body covered with more or less definite tubercles: fr. naked.
E. The plant terminated by a cephalium 13. *Cactus.*
EE. The plant without a terminal cephalium.
F. Without spines except in the seedlings.
G. Plant tumid, without woody tubercles.... 14. *Lophophora.*
GG. Plant with dry prominent woody tubercles.... 15. *Ariocarpus.*
FF. With spines on the tubercles.
G. Tubercles terete or angled, with various kinds of spines.... 16. *Mammillaria.*
GG. Tubercles flattened, with pectinate spines.... 17. *Pelecyphora.*
DD. Plant-body covered with more or less definite ribs: fr. scaly.
E. Tubercles elongated, finger-like.... 18. *Leuchtenbergia.*
EE. Tubercles, if present, always low.
F. Top of plant naked or nearly so.. 19. *Echinocactus.*
FF. Top of plant very woolly.... 20. *Malacocarpus.*
CC. Sts. often tall, cylindrical, more-or-less branched, erect or climbing, sometimes low and then always with spiuy fr.
D. Flowering plants taking on various forms like a cephalium, long hairs or wool, peculiar bristles or spines from near the top.
E. Ribs of sts. 4–7.... 21. *Lophocereus.*
EE. Ribs of sts. many.

FF. Fls. diurnal; flowering areoles with acicular spines, but no wool. 22. *Carnegiea.*
FF. Fls. nocturnal; wool or hairs usually produced in abundance with the fls.
G. Ovary and fr. nearly smooth, the few minute bracts with no hairs in their axils. 23. *Cephalocereus.*
GG. Ovary and fr. covered with bracts with long hairs in their axils. 24. *Oreocereus.*
DD. Flowering plants not different from the sterile plants.
E. Plants tall erect trees.
F. Fl., after withering, dropping from the ovary. 25. *Cereus.*
FF. Fl., after withering, persisting on the ovary.
G. Fr. and fls. minute, often several coming from each flowering areole. 26. *Myrtillocactus.*
GG. Fr. and fls. medium-sized or larger, only 1 coming from each flowering areole.
H. Ovary and fr. covered with thin scales, but no fls. 27. *Escontria.*
HH. Ovary and fr. spiny but not bearing large chartaceous scales.
I. The fr. edible, juicy. 28. *Lemaireocereus.*
II. The fr. dry. 29. *Pachycereus.*
EE. Plants low, often vines; or, if at first elongated and erect, finally becoming procumbent or clambering.
F. Fls. nocturnal.
G. Fr. smooth, yellow. 30. *Harrisia.*
GG. Fr. spiny, red.
H. Sts. producing an abundance of aërial roots. 31. *Selenicereus.*
HH. Sts. not producing an abundance of aërial roots.
I. Ribs usually 3. 32. *Acanthocereus.*
II. Ribs 10 or more. 33. *Nyctocereus.*
FF. Fls. diurnal.
G. The fls. irregular, narrow.
H. Sts. slender, weak. 34. *Aporocactus.*
HH. Sts. stout, at first erect.
I. Fr. spiny, with red pulp. 35. *Rathbunia.*
II. Fr. not spiny, with white pulp. 36. *Cleistocactus.*
GG. The fls. regular.
H. Fl.-tube much elongated; spines on the ovary reduced to stiff bristles. 37. *Echinopsis.*
HH. Fl.-tube short, at least never much elongated.
I. Plants producing a cluster of tubers. 38. *Wilcoxia.*
II. Plants without tubers.
J. Usually stout but low, sometimes procumbent: stigmas green. 39. *Echinocereus.*
JJ. Viny; stigmas not green. [reus.
K. Fls. small, yellow. 40. *Bergerocactus.*
KK. Fls. large, red or white. 41. *Heliocereus.*

Epiphyllanthus and Pterocactus are described.

95. AIZOACEÆ.

A. Petals numerous: caps. 5- or more valved. 1. *Mesembryanthemum.*
AA. Petals 0: drupe 3–8-stoned. 2. *Tetragonia.*
AAA. Petals 5–∞: caps. circumscissile. 3. *Sesuvium.*

96. UMBELLIFERÆ.

Key condensed from Coulter & Rose's "Monograph of North American Umbelliferæ." Not arranged in aequence of relationship.

A. Fls. in dense heads. 1. *Eryngium.*
AA. Fls. not in heads, evidently umbellate.
B. Fr. conspicuously bristly.
C. The fr. covered with spines or hooked bristles. 2. *Sanicula.*
CC. The fr. with bristles only on the ribs. 3. *Daucus.*
BB. Fr. not bristly (except Osmorhiza and Cuminum).
C. Oil-tubes obsolete or obscure.
D. The fr. strongly flattened laterally: lvs. simple. 4. *Hydrocotyle.*
DD. The fr. not strongly flattened.
E. Seed-face concave.
F. Stylopodium conical.
G. At base, fr. attenuate. 5. *Osmorhiza.*
GG. At base, fr. rounded.
H. Ribs slender. 6. *Scandix.*
HH. Ribs broad, 3-angled, or almost wing-like. 7. *Myrrhis.*
FF. Stylopodium flat or wanting.
G. Lvs. simple and perfoliate. 8. *Bupleurum.*
GG. Lvs. large and decompound. 9. *Conium.*
EE. Seed-face plane. 10. *Ægopodium.*
CC. Oil-tubes distinct.
D. Dorsally the fr. strongly flattened, with lateral ribs more or less prominently winged (see Musineon).
E. The oil-tubes solitary in the intervals between the ribs, rarely 2.
F. Stylopodium conical.
G. Slender and glabrous plants. 11. *Oxypolis.*
GG. Stout and pubescent, at least in the umbel. 12. *Heracleum.*
FF. Stylopodium flat or wanting.
G. Plants caulescent and branching.
H. Color of fls. white.
I. Lvs. pinnately dissected; dorsal ribs filiform: plant slender. 13. *Anethum.* (See Dill.)
II. Lvs. ternately or pinnately decompound: dorsal ribs prominent but slender: plant stout. 14. *Angelica.*
III. Lvs. pinnately decompound; dorsal ribs winged: plant stout. 15. *Selinum.*
HH. Color of fls. yellow.
I. Dorsal ribs prominent. 16. *Levisticum.*
II. Dorsal ribs filiform. 17. *Pastinaca.*
GG. Plants acaulescent or nearly so. 18. *Lomatium.*
EE. The oil-tubes more than 1 in the intervals, usually several.
F. Plants caulescent or nearly so: fls. yellow or white. 18. *Lomatium.*
FF. Plants caulescent and branching.
G. Fr. winged: fls. white. 19. *Archangelica.*
GG. Fr. not winged: fls. yellow. 20. *Ferula.* [ica.
DD. Dorsally the fr. not strongly flattened, usually more or less laterally flattened.
E. The oil-tubes solitary in the intervals between the ribs.
F. Stylopodium conical: lfts. linear or filiform.
G. Involucre wanting.
H. Fls. white. 21. *Coriandrum.*
HH. Fls. yellow. 22. *Fœniculum.*
GG. Involucre present.
H. Fls. rose-color: fr. bristly. 23. *Cuminum.*
HH. Fls. white: fr. smooth. 24. *Carum.*
FF. Stylopodium flat or wanting.
G. Fls. white. 25. *Apium.*
GG. Fls. yellow. (See article Celery.)
H. Ribs equal, broad and corky. 26. *Petroselinum.*
HH. Ribs winged or filiform. [num.
I. The ribs conspicuously winged. 27. *Thaspium.*
II. The ribs filiform. 28. *Zizia.*
EE. The oil-tubes more than 1 in the intervals.
F. Stylopodium conical. 29. *Ligusticum.*
FF. Stylopodium flat or wanting.
G. Seed-face sulcate or decidedly concave.
H. Carpels flattened dorsally. 30. *Musineon.*
HH. Carpels strongly flattened laterally. 31. *Erigenia.*
GG. Seed-face plane or but slightly concave.
H. Ribs all filiform: lfts. entire. 32. *Tænidia.*
HH. Ribs corky at least the lateral.
I. Lvs. simple and perfoliate: oil-tubes continuous about seed-cavity. 8. *Bupleurum.*
II. Lvs. pinnate, usually serrate: oil-tubes 1–3 in the intervals. 33. *Sium.*

The following genera are also treated: Aciphylla, Arracacia, Astrantia, Chærophyllum, Crithmum, Dorema, Hacquetia, Meum, Molopospermum, Peucedanum, Portenschlagia, and Seseli.

97. ARALIACEÆ.

A. Petals more or less imbricate, broadly affixed at base.
B. Lvs. pinnate.
C. Lfts. entire or indistinctly crenate: ovary 2-celled: glabrous evergreen shrubs. 1. *Delarbrea.*
CC. Lfts. serrate: ovary 2–5-celled: herbs or small deciduous trees. 2. *Aralia.*
BB. Lvs. digitate, whorled: fls. in simple terminal umbels; styles 2–3, distinct in the fertile fls.: herbs. 3. *Panax.*

AA. Petals valvate.
B. Pedicels jointed or fls. sessile: evergreen tropical or subtropical trees or shrubs.
C. Fls. pedicelled.
D. Lvs. 1-3-pinnate: ovary 1–10-celled; styles usually distinct. . . . 4. *Polyscias.*
DD. Lvs. digitate or occasionally simple: styles 5, distinct. . . . 5. *Pseudo-*[*panax.*
CC. Fls. sessile; ovary usually 5-celled, rarely 1–4- or 6–12-celled; endosperm usually ruminate: lvs. usually simple and lobed, rarely digitate. . . . 6. *Oreopanax.*
BB. Pedicels not jointed.
C. Lvs. digitate.
D. Anthers 4-celled; ovary 10-celled, styles distinct: evergreen. . . . 7. *Dizygotheca.*
DD. Anthers 2-celled; styles usually connate.
E. Stipules wanting: lvs. deciduous: ovary 2–5-celled. . . . 8. *Acantho-*[*panax.*
EE. Stipules developed: lvs. evergreen: ovary 5- to many-celled. . . . 9. *Schefflera.*
CC. Lvs. simple, usually lobed.
D. Fls. 4- or 8–12-merous: lvs. palmately lobed, large.
E. Styles, connate into a column: fls. 8–12-merous. . . . 10. *Trevesia.*
EE. Styles distinct, 2: fls. 4-merous: lvs. deciduous. . . . 11. *Tetrapanax.*
DD. Fls. 5-merous, rarely 5–8-merous.
E. With distinct styles.
F. Shrub, evergreen, unarmed: styles 5. . . . 12. *Fatsia.*
FF. Shrub deciduous, prickly: styles 2. . 13. *Echino-*[*panax.*
EE. With connate styles.
F. Habit climbing: endosperm ruminate: lvs. simple, usually lobed, evergreen. . . . 14. *Hedera.*
FF. Habit upright.
G. Ovary 5–8-celled; calyx indistinctly toothed: lvs. usually entire, occasionally 2–5-lobed, evergreen. . . . 15. *Gilibertia.*
GG. Ovary 2-celled; calyx with 5 short teeth: lvs. palmately lobed or digitate, deciduous. . . 8. *Acantho-*[*panax.*

Meryta and Tupidanthus are also in cultivation.

98. GARRYACEÆ.

The only genus . . . . . *Garrya.*

99. NYSSACEÆ.

A. Ovary 1-celled; calyx minute; petals usually 5: pistillate and staminate fls. in distinct heads with small deciduous bracts. . . . 1. *Nyssa.*
AA. Ovary 6–10-celled; perianth 0 in staminate fls.; heads consisting of 1 pistillate fl. and numerous staminate fls. with 2 or 3 very large white bracts at the base. . . . 2. *Davidia.*

100. ALANGIACEÆ.

The only genus. . . . . *Alangium.*

101. CORNACEÆ.

A. Fls. bisexual, usually in cymes; petals short, valvate; ovary 2-celled: lvs. usually opposite. . . . 1. *Cornus.*
AA. Fls. unisexual.
B. Lvs. opposite, evergreen: fls. in terminal panicles; ovary 1-celled. . . . 2. *Aucuba.*
BB. Lvs. alternate.
C. Petals valvate, 4: fls. in few-fld. cymes on the upper surface of the lvs. . . . 3. *Helwingia.*
CC. Petals imbricate, 5: fls. in terminal racemes or panicles. . . . 4. *Griselinia.*

102. CAPRIFOLIACEÆ.

A. Corolla rotate or nearly so; limb regular; style short, deeply 2–5-cut.
B. Lvs. pinnately cut. . . . 1. *Sambucus.*
BB. Lvs. simple. . . . 2. *Viburnum.*
AA. Corolla tubular or bell-shaped; limb usually irregular; style long, usually with capitate stigma.
B. Ovary 2–5-celled; all the cells 1-ovuled: herbs with rather small whorled fls. . . . 3. *Triosteum.*
BB. Ovary 3–4-celled; 1 or 2 cells 1-ovuled, the others with numerous ovules.
C. Fr. a berry, usually 2-seeded: corolla campanulate or tubular-funnelform, nearly regular . . . . 4. *Symphori-*[*carpos.*
CC. Fr. a leathery achene.
D. Achene inclosed between large peltate bracts: corolla campanulate-funnelform, 2-lipped: ovary 4-celled. . . . 5. *Dipelta.*
DD. Achene not inclosed between bracts: ovary 3-celled; corolla nearly or quite regular.
E. Ovary narrow; sepals 2–5, large, persistent; corolla tubular or campanulate-funnelform. . . . 6. *Abelia.*
EE. Ovary subglobose; sepals 5, lanceolate deciduous; corolla campanulate-funnelform: trailing undershrub with the fls. in pairs on slender upright stalks. . . . 7. *Linnæa.*
BBB. Ovary 2–8-celled, the cells with many ovules or 1 cell empty.
C. Fr. an achene or caps.
D. Stamens 4: fls. in coalescent pairs inserted at unequal height; ovary 3-celled, often 1 cell empty: fr. an achene. . . . 8. *Kolkwitzia.*
DD. Stamens 5: fls. in cymes: fr. a 2-celled dehiscent caps. . . . 9. *Diervilla.*
CC. Fr. a berry.
D. Cells of ovary 2–3, rarely 4–5: fls. in pairs or whorls; calyx deciduous . . . . 10. *Lonicera.*
DD. Cells of ovary 5–8: fls. in whorls; calyx persistent . . . . 11. *Leycesteria.*

Alseuosmia is also briefly treated.

103. RUBIACEÆ.

I. Summary of Tribes.

Ignoring exceptions and omitting eight tribes not within the scope of this work.

A. Number of ovules in each locule ∞.
B. Fr. dry, capsular or 2–5-berried or nutlike.
C. Fls. compacted or confluent into a spherical head. . . . 1. NAUCLEA TRIBE.
CC. Fls. not disposed in a spherical head.
D. Seeds winged or appendaged, with endosperm: caps. 2-celled. 2. CINCHONA TRIBE.
DD. Seeds not winged.
E. Corolla valvate.
F. The seeds with endosperm: caps. 2-celled. . . . 3. CONDAMINEA [TRIBE.
FF. The seeds minute: fr. indehiscent, 2-berried or capsular, 2–4-celled. . . . 4. HEDYOTIS TRIBE.
EE. Corolla imbricate or convolute: caps. 2-celled; seeds with endosperm. . . . 5. RONDELETIA [TRIBE.
BB. Fr. fleshy, bursting irregularly or dehiscent at apex, or a drupe with 2 or more stones, the stones many-seeded.
C. Corolla valvate: seeds numerous, minute, angled. . . . 6. MUSÆNDA TRIBE.
CC. Corolla imbricate or convolute: seeds numerous, minute, often angled. . . . 7. HAMELIA TRIBE.
CCC. Corolla strictly convolute: seeds numerous or few, large and compressed or smaller and angled. . . . 8. GARDENIA TRIBE.
AA. Number of ovules in each locule 1.
B. Radicles superior.
C. Stamens inserted at base of corolla; corolla valvate or imbricate. . . . 9. CHIOCOCCA TRIBE.
CC. Stamens inserted at throat of corolla.
D. Corolla strictly convolute. . . . 10. ALBERTA TRIBE.
DD. Corolla valvate. . . . 11. VANGUERIA TRIBE.
BB. Radicles inferior.
C. Corolla strictly convolute. . . . 12. IXORA TRIBE.
CC. Corolla valvate.
D. Ovules affixed to septum, rarely basilar, generally amphitropous: trees and shrubs. . . . 13. MORINDA TRIBE.
DD. Ovules affixed to septum, amphitropous or anatropous: herbs. . . . 14. GALIUM TRIBE.
DDD. Ovules basilar, erect, anatropous.
E. Stamens inserted on the throat of the corolla: fr. indehiscent: style entire or with short branches. . . . 15. PSYCHOTRIA TRIBE.

EE. Stamens inserted on the throat, rarely at base of corolla: fr. capsular or 2-berried: style-branches filiform.....16. PÆDERIA TRIBE.

EEE. Stamens inserted at base of corolla, rarely on throat: fr. berry-like or indehiscent: style entire or with long branches.....17. ANTHOSPERMA [TRIBE.

II. Key to the Tribes.

1. Nauclea Tribe.

Calyx-tubes confluent: fr. a globose, fleshy syncarp: ovary 2-celled; ovules solitary, pendulous..... 1. *Cephalanthus.*

2. Cinchona Tribe.

A. Corolla valvate.
B. Placentæ ascending from the base of the septum, or erect..... 2. *Manettia.*
BB. Placentæ adnate to the middle of the septum.
C. Caps. septicidal..... 3. *Cinchona.*
CC. Caps. loculicidal..... 4. *Bouvardia.*
AA. Corolla imbricate; stamens inserted in the throat.
B. Sepals never bract-like..... 5. *Luculia.*
BB. One of the sepals in some fls. in each infl. developing into a large white persistent appendage..... 6. *Emmenopterys.*

3. Condaminea Tribe.

One calyx-lobe dilated into an ample colored blade..... 7. *Pinckneya.*

4. Hedyotis Tribe.

A. Calyx-lobea unequal: caps. loculicidal..... 8. *Pentas.*
AA. Calyx-lobea equal: caps. loculicidal at the top..... 9. *Houstonia.*

5. Rondeletia Tribe.

Corolla imbricate, lobes equal or nearly so.....10. *Rondeletia.*

6. Mussænda Tribe.

Infl. terminal, corymbose; ovary 1–2-celled; calyx-lobes 5, 1 dilated and colored.....11. *Mussænda.*

7. Hamelia Tribe.

A. Corolla 5-ribbed: berry 5-celled.....12. *Hamelia.*
AA. Corolla 4–5-lobed: berry 2–3-celled.....13. *Hoffmannia.*

8. Gardenia Tribe.

A. Infl. usually terminal.
B. Corolla-tube short.....14. *Burchellia.*
BB. Corolla-tube long.
C. Calyx 5-toothed.....15. *Posoqueria.*
CC. Calyx-lobes large and leafy.....16. *Leptactina.*
AA. Infl. usually axillary.
B. Style has a spindle or club-shaped atigma, entire or 2-toothed.
C. Seed-coat membranous.
D. Calyx-limb various; ovary 2-celled.....17. *Randia.*
DD. Calyx-limb often tubular; ovary 1-celled.....18. *Gardenia.*
CC. Seed-coat fibrous or subfibrous.
D. Corolla-tube long and slender.....19. *Oxyanthus.*
DD. Corolla-tube short.
E. Calyx 5-parted..... 20. *Mitriostigma.*
EE. Calyx truncate or 5-toothed.....21. *Genipa.*
BB. Style-branches 2, distinct (except sometimes in Kraussia).
C. Throat of corolla bearded.....22. *Kraussia.*
CC. Throat of corolla glabrous.....23. *Tricalysia.*

9. Chiococca Tribe.

Corolla valvate: infl. axillary, racemose; anthers dorsifixed; stigma club-shaped.....24. *Chiococca.*

10. Alberta Tribe.

Infl. terminal; the 2–4 calyx-lobea dilated; anthers pilose on back.....25. *Alberta.*

11. Vangueria Tribe.

A. Drupe 1–2-stoned.....26. *Plectronia.*
AA. Drupe 3–6-stoned.....27. *Vangueria.*

12. Ixora Tribe.

A. Fls. clustered in axils.....28. *Coffea.*
AA. Fls. in 2–3-forking corymbs.
B. Style-branches 2, short, rarely connate: lvs. leathery.....29. *Ixora.*
BB. Style very far exserted, the slender spindle-shaped atigma usually long: lvs. usually membranous.....30. *Pavetta.*

13. Morinda Tribe.

A. Fls. confluent in heads, which are many-fld., solitary or umbellate.....31. *Morinda.*
AA. Fls. free; calyx-limb 4–5-fid; corolla villous at throat; atigma club-shaped, 2–4-lobed: drupe 1–4-stoned: infl. axillary.....32. *Damnacanthus.*

14. Galium Tribe.

A. Corolla funnel-shaped or somewhat tubular.
B. Fls. 4-merous, with or without bracts, but no bractlets; style-branches subequal.....33. *Asperula.*
BB. Fls. 4–5-merous, bracted and with 2 bractlets; style-branches unequal.....34. *Crucianella.*
AA. Corolla rotate or rotate-campanulate.
B. Fls. 5-merous.....35. *Rubia.*
BB. Fls. 4-merous.....36. *Galium.*

15. Psychotria Tribe.

Infl. terminal; calyx usually 5-toothed; corolla 5-lobed, rarely 4-lobed; tube usually short.....37. *Psychotria*

16. Pæderia Tribe.

A. Ovary 2-celled; stigma 2, capillary, twisted: fr. drupaceous: twining plant.....38. *Pæderia.*
AA. Ovary 5-celled: fr. a caps.: small upright shruba.....39. *Leptodermis.*

17. Anthosperma Tribe.

A. Stamens inserted in throat; style-branches 4....40. *Mitchella.*
AA. Stamens inserted at or near base of corolla.
B. Fls. bisexual; style shortly 2-cut: shrub....41. *Serissa.*
BB. Fls. unisexual or bisexual; style 2-parted to the base or near it.
C. Plants are creeping herbs.....42. *Nertera.*
CC. Plants are shruba or small trees.....43. *Coprosma.*

Other genera incidentally described are: Catesbæa, Cephaelis, Exostemma, Fernelia, Guettarda, Oldenlandia, Plocama, and Sarcocephalus.

104. VALERIANACEÆ.

A. Stamens 4..... 1. *Patrinia.*
AA. Stamens 1, rarely 2: corolla-tube spurred, the limb spreading..... 2. *Centranthus.*
AAA. Stamens 2; corolla-tube spurred, the limb 2-lipped..... 3. *Fedia.*
AAAA. Stamens usually 3.
B. Calyx-limb finally pappiform..... 4. *Valeriana.*
BB. Calyx-limb various but not pappiform..... 5. *Valerianella.*

105. DIPSACACEÆ.

A. Stigma terminal, atraight: fls. densely crowded in the axils of the floral lva., forming whorls after the manner of the mint family..... 1. *Morina.*
AA. Stigma oblique or lateral, rarely straightish: fls. in terminal heads.
B. Bracts of involucre generally herbaceous; chaff of receptacle rigidly awl-shaped-acuminate or spinescent; corolla 4-fid..... 2. *Dipsacus.*
BB. Bracts and chaff rigidly paleaceous, rarely sub-herbaceous; corolla 4-fid..... 3. *Cephalaria.*
BBB. Bracts leafy, in about 2 series; chaff short, or very narrow or abortive; corolla 4–5-cut..... 4. *Scabiosa.*

106. COMPOSITÆ.

I. Summary of Tribes.

Series 1. TUBULIFLORÆ. Corollas tubular and regular in all the bisexual fls.

A. Heads composed entirely of disk-fls., which are all perfect and never truly yellow.
B. Style-branchea awl-shaped, acute, minutely hairy: lvs. generally alternate: anthers sagittate at base.... 1. VERNONIA TRIBE.

BB. Style-branches subterete, obtuse, covered with minute papillæ: lvs. opposite or alternate: anthers subentire at base ... 2. EUPATORIUM [TRIBE.

AA. Heads with all perfect or some imperfect fls., with or without rays and often yellow.

B. Anthers tailed.

C. Style-branches linear: heads with or without rays ... 3. INULA TRIBE.

CC. Style-branches united or short; heads without rays; typically with spiny or scarious appendaged, many-bracted involucre and fleshy receptacle ... 4. CYNARA TRIBE.

BB. Anthera not conspicuously tailed.

C. Style-branches in disk-fls. flattened out, and with a distinct though sometimes very short terminal appendage ... 5. ASTER TRIBE.

CC. Style-branches not flattened out.

NOTE.—It is impossible to make a key to separate the following tribes from one another. Some of the important characters are italicized:

Receptacle chaffy or rarely naked under the sterile disk-fls.: style-branches truncate or appendaged or the style of the sterile fls. undivided; *pappus* sometimes absent but generally of 2–4 *awns*, which are slender or somewhat chaffy and with or without intermediate scales which are free or connate at base: *lvs. opposite*, rarely alternate ... 6. HELIANTHUS [TRIBE.

Receptacle naked; style-branches truncate or appendaged; pappus usually chaffy, rarely of awns or bristles, or absent: *lvs. opposite or alternate: involucral bracts in 1 or 2 series*, rarely 3–4, *herbaceous or membranous: herbage often resinous-dotted* ... 7. HELENIUM TRIBE.

Receptacle chaffy or naked; style-branches truncate; *pappus* when present *crown-shaped*, rarely of short chaff: lvs. mostly alternate: *involucral bracts* in 2 or more series, *dry or scarious at apex* ... 8. ANTHEMIS TRIBE.

Receptacle usually naked; style-branches truncate or appendaged; *pappus* usually of *bristles:* lvs. mostly alternate: *inner involucral bracts in 1 series, subequal, the outer ones small or wanting*, or rarely all imbricate in numerous series ... 9. SENECIO TRIBE.

Receptacle naked; style-branches truncate or the style of the sterile fls. undivided; *pappus absent or wool-like: lvs. usually alternate or radical:* involucral bracts in 1–2 series, subequal, *narrow* ... 10. CALENDULA TRIBE.

Receptacle naked, chaffy or alveolate; style-branches rounded at apex, obtuse or rarely truncate or the style of the sterile fls. undivided; pappus absent, or chaffy or crown-shaped: *lvs. radical* or alternate: involucral *bracts* in an *indefinite* number of series, often scarious at apex or spinescent ... 11. ARCTOTIS TRIBE.

Series 2. LABIATÆFLORÆ. Corollas of all or only of the bisexual fls. bilabiate ... 12. MUTISIA TRIBE.

Series 3. LIGULIFLORÆ. Corollas all ligulate and fls. bisexual: juice milky ... 13. CICHORIUM TRIBE.

II. Artificial Key to the Composite Tribes.

(Condensed from Engler & Prantl.)

A. Plants without milky juice: corolla of disk-fls. not ligulate (except some of the Mutisia Tribe, recognized by the peculiar style and caudate anthers).

B. Style below its point of branching neither thickened nor with a ring of long sweeping hairs.

C. Anthers not caudate.

D. Style-branches awl-shaped, acute, minutely hairy outside and often on style below, stigmatose over the whole inner face ... VERNONIA TRIBE.

DD. Style-branches subterete, obtuse, covered with minute papillæ, stigmatose in 2 lines near the base ... EUPATORIUM TRIBE.

DDD. Style-branches flattened, with distinct though often short-terminal, usually short-hairy appendages, stigmatose in 2 lines ... ASTER TRIBE.

DDDD. Style-branches flattened, stigmatose in 2 lines, very diverse in form (i. e., truncate or appendiculate, but with a distinct tendency toward a ring of long sweeping hairs somewhere above the fork (transitions frequent to the above 3 tribes).

E. Pappus not capillary, but composed of scales, plumose bristles, or strong awns, or crown-like or wanting.

F. Involucral bracts without scarious margins, rarely with narrow membranous margins (in some genera which may be separated by strongly developed scaly pappus from the Anthemis Tribe).

G. Chaff present ... HELIANTHUS TRIBE.

GG. Chaff absent ... HELENIUM TRIBE.

FF. Involucral bracts scarious margined: pappus 0 or reduced, sometimes unilaterally developed ... ANTHEMIS TRIBE.

EE. Pappus capillary, simple ... SENECIO TRIBE.

DDDDD. Style-branches of the bisexual fls. (which are sterile) almost or quite wanting, rarely of normal size, not stigmatose.

E. Plants more or less completely dicœcious: chaff 0.

F. Involucral bracts in 1 row, of equal length (often with tiny bracteoles at the base) ... *Petasites.*

FF. Involucral bracts in many rows ... *Baccharis.*

EE. Plants not dicœcious: heads bisexual.

F. Chaff 0.

G. Achene of female fls. with pappus of coarse or fine bristles or hairs, sometimes plumose.

H. Involucral bracts in several rows ... Some members of ASTER TRIBE.

HH. Involucral bracts in 1 row, separate, with tiny bracteoles at base ... *Tussilago.*

HHH. Involucral bracts in 1 row, connate at base. *Othonna* and [*Gamolepis.*

GG. Achene of female fls. with scaly pappus ... *Gutierrezia.*

GGG. Achene of female fls. with no pappus.

H. Lvs. opposite or radical ... *Osteospermum.*

HH. Lvs. alternate ... Some members of CALENDULA TRIBE.

FF. Chaff present.

G. Involucre not scarious, nor woolly (see Milampodineæ and Ambrosieæ of the Helianthus Tribe).

GG. Involucre scarious margined; inner bracts woolly ... *Eriocephalus.*

CC. Anthers caudate.

D. Style-branches awl-shaped, acute, minutely hairy outside and often on style below, stigmatose on whole inner face ... Members of VERNONIA TRIBE.

DD. Style-branches otherwise.

E. Limb of corolla of bisexual fls. 5- (rarely 4-) toothed or -lobed, rarely, in the Inula Tribe, slightly 2-lipped.

F. Plants dicœcious ... *Antennaria.*

FF. Plants not dicœcious.

G. Heads with filiform female marginal fls., or fls. all alike. Some members of INULA TRIBE.

GG. Heads with fls. of 2 sexes: corolla of female fls. (marginal) ligulate, rarely tubular, with broad regular or 2-lipped limb.

H. Pappus present ... Some members of INULA TRIBE.

HH. Pappus 0 ... CALENDULA TRIBE.

EE. Limb of corolla of bisexual fls. regular and deeply 5-divided or 2-lipped. . . . . MUTISIA TRIBE.
BB. Style with sweeping hairs beginning at or below the point of forking, forming a ring; or style there thickened, or at least there different in color: style-branches often coherent.
C. Head with female or neutral ligulate ray-fls. . . . . ARCTOTIS TRIBE.
CC. Head of all bisexual fls. or with nonligulate neutral fls. or rarely with female ray-fls. . . . . CYNARA TRIBE.
AA. Plants with milky juice: fls. in head all ligulate. . . . . CICHORIUM TRIBE.

III. Regular Key to the Tribes.

1. Vernonia Tribe.

A. Genus anomalous with enlarged palmately quasiligulate outer corollas. . . . . 1. *Stokesia.*
AA. Genus normal with tubular 5-lobed corollas. . . 2. *Vernonia.*

2. Eupatorium Tribe.

A. Anthers truncate at apex, not appendaged: achenes 5-angled, secondary ribs not prominent. . . . . 3. *Piqueria.*
AA. Anthers appendaged.
B. Achenes 5-ribbed, no secondary ribs visible.
C. Pappus wholly of capillary bristles.
D. Involucral bracts 4. . . . . 4. *Mikania.*
DD. Involucral bracts more than 4. . . . . 5. *Eupatorium.* (Incl. Conoclinium.)
CC. Pappus chaffy, awned, blunt or crown-shaped. . . . . 6. *Ageratum.*
BB. Achenes 10-ribbed (rarely 7–8-ribbed), secondary ribs conspicuous.
C. Involucral bracts not herbaceous, striate-nerved, conspicuously so when dry.
D. Heads few-fld., corymbose . . . . . 7. *Adenostyles.*
DD. Heads always paniculate. . . . . 8. *Brickellia*
CC. Involucral bracts somewhat herbaceous or partly colored, inconspicuously striate if at all.
D. The outer bracts successively shorter. . . 9. *Liatris.*
DD. The bracts nearly all equal in length. . . . 10. *Trilisa.*

3. Inula Tribe.

A. The fls. containing both stamens and pistil all sterile, only the unisexual fls. fertile; heads monœcious or dicœcious.
B. Pappus bristles, especially of fertile fls., united at the base in a ring.
C. Heads strictly dicœcious, corymbose, rarely solitary; sterile pappus club-shaped. . . . . 11. *Antennaria.*
CC. Heads containing 1 or both sexes, monœcious or dicœcious, crowded in a small cluster or cyme surrounded by a long conspicuous woolly involucre . . . . . 12. *Leontopodium.*
BB. Pappus bristles free: involucre rosette-like, very white-papery. . . . . 13. *Anaphalis.*
AA. The fls. containing both stamens and style usually fertile.
B. Heads with disk-fls. only.
C. The heads compound; 1-fld. heads aggregated in an involucrate cluster, often with petaloid appendages. . . . . 14. *Myriocephalus.*
CC. The heads simple.
D. Pappus 0 . . . . . 15. *Humea.*
DD. Pappus crown- or cup-shaped . . . . . 16. *Ammobium.*
DDD. Pappus bristly.
E. Achenes not beaked.
F. Bristles often plumose at base. . . . 17. *Helipterum.*
FF. Bristles smooth, scarious, barked or plumose at apex. . . . . 18. *Helichrysum.*
EE. Achenes beaked . . . . . 19. *Waitzia.*
BB. Heads composed of both ray- and disk-fls.
C. Receptacle not chaffy.
D. Stigmatic lines not confluent at apex. . 20. *Podolepis.*
DD. Stigmatic lines fusing at apex . . . . . 21. *Inula.*
CC. Receptacle chaffy or bristly . . . . . 22. *Buphthalmum.*

4. Cynara Tribe.

A. Heads 1-fld., aggregated into larger involucrate heads. . . . . 23. *Echinops.*
AA. Heads several-fld.
B. Fr. with basal areole.
C. The fr. woolly, not margined.
D. Pappus scales pointed or terminated by a simple awn . . . . . 24. *Xeranthemum.*
DD. Pappus-scales plumose . . . . . 25. *Carlina.*
CC. The fr. glabrous, marginal at summit.
D. Receptacle bristly.
E. Filaments glabrous: involucre bracts hooked . . . . . 26. *Arctium.*
EE. Filaments warty, hairy, or pectinate-ciliate.
F. The receptacle not fleshy.
G. Pappus-bristles not plumose. . . . 27. *Carduus.*
GG. Pappus-bristles plumose . . . . . 28. *Cirsium.*
FF. The receptacle fleshy. . . . . 29. *Cynara.*
DD. Receptacle not bristly. . . . . 30. *Onopordon.*
BB. Fr. with oblique lateral areole.
C. Heads not involucrate with lvs.
D. Involucral-bracts without appendages. 31. *Serratula.*
DD. Involucral-bracts with dry, scarious or thorny appendages. . . . . 32. *Centaurea.*
CC. Heads surrounded by an involucre of thorny lvs.
D. Pappus simple, of bristles, scales or 0. . . 33. *Carthamus.*
DD. Pappus of 2 unequally long rows of bristles . . . . . 34. *Cnicus.*

5. Aster Tribe.

A. Heads dicœcious and composed wholly of disk-fls. . . . . 35. *Baccharis.*
AA. Heads not dicœcious.
B. Color of fls. yellow.
C. Rays absent. . . . . 36. *Bigelovia.*
CC. Rays present.
D. The pappus composed of long paleæ, which are sometimes reduced to a crown. . . . . 37. *Gutierrezia.*
DD. The pappus not as in D.
E. Pappus-bristles few (4–8).
F. Involucral bracts in 8 series, leathery or scarious at apex. . . . . 38. *Grindelia.*
FF. Involucral bracts in 2–3 series, scarious at margins. . . . . 39. *Pentachæta.*
EE. Pappus-bristles copious, in 2–8 series, sometimes few in ray-fls.
F. Bristles of 2 kinds, the inner series capillary, outer very short and setulose or squamellate. . . . . 40. *Chrysopsis.*
FF. Bristles mostly alike.
G. Rays usually wanting. . . . . 41. *Linosyris.*
GG. Rays present.
H. The bristles broad at base, aristate. . . . . 42. *Xanthisma.*
HH. The bristles capillary.
I. Heads usually many-fld.
J. Achenes many-nerved. . . . 43. *Aplopappus.*
JJ. Achenes few-nerved. . . . . 44. *Hazardia.*
II. Heads usually few-fld.
J. Bristles rudimentary, shorter than achene. . . 45. *Brachychæta.*
JJ. Bristles longer than achene. . . . . 46. *Solidago.*
BB. Color of ray fls. at least not yellow.
C. The pappus 0, or forming a more-or-less conspicuous ring of short bristles or hairs, uniform in all fls.
D. Bracts dry or scarious at margin. . . . . 47. *Brachycome.*
DD. Bracts herbaceous. . . . . 48. *Bellis.*
CC. The pappus composed of numerous bristles in 1 or more series, uniform in all fls.
D. Involucre with outer bracts partly leafy, inner bracts membranous or scarious. . . . . 49. *Callistephus.*
DD. Involucral bracts all nearly alike.
E. Bracts in about 2 series.
F. Achenes usually small. . . . . 50. *Erigeron.*
FF. Achenes larger, longer: pappus more copious. . . . . 51. *Vittadinia.*
EE. Bracts usually in several series, sometimes 2 series in Aster and Felicia.
F. Plants woody, resinous.
G. Achenes cylindrical. . . . . 52. *Olearia.*
GG. Achenes compressed. . . . . 53. *Felicia.*
FF. Plant herbaceous.
G. Involucral bracts coriaceous . . . . 54. *Sericocarpus.*
GG. Involucral bracts membranous or herbaceous. . . . . 55. *Aster.*
CCC. The pappus anomalous or absent from the rays.
D. Pappus-bristles shortly plumose; style-branches broad. . . . . 56. *Charieis.*
DD. Pappus-bristles in 1 series, unequal, rigid, thickened or dilated toward the base. . . . . 57. *Townsendia.*
DDD. Pappus of the ray composed of very short paleæ; disk-pappus of copious slender bristles in 1–2 series. . . . . 58. *Heteropappus.*
DDDD. Pappus-bristles very short, usually accompanied by 2–4 awns not longer than the achene. . . . . 59. *Boltonia.*

6. Helianthus Tribe.

Subtribe 1. MELAMPODIEÆ. Rays pistillate; disk-fls. staminate: achenes usually with coriaceous or thicker pericarp: style mostly entire; receptacle chaffy throughout; pappus none.

A. Involucre of the many-fld. heads broad; inner bracts concave, embracing and half inclosing the thick, turgid, obovoid achenes..60. *Polymnia.*
AA. Involucre broad, of plane or barely concave bracts; innermost subtending obcompressed achenes, but not inclosing nor embracing them.
B. Rays, or rather their ovaries and achenes, in more than 1 series.....61. *Silphium.*
BB. Rays and achenes in a single series.
C. Heads nearly discoid or rays short.....62. *Parthenium.*
CC. Heads conspicuously radiate, mostly of 5 fertile and rather numerous sterile fls..63. *Chrysogonum.*

Subtribe 2. AMBROSIEÆ. Pistillate fls. apetalous, or with corolla reduced to a tube or ring around base of 2-parted style; staminate fls. with 4–5-lobed corolla; anthers slightly united or free; style abortive, hairy only at the somewhat enlarged and depressed summit.

A. Herbs: heads of 2 kinds, the fertile with a bur-like involucre.....64. *Ambrosia.*
AA. Shrubs: heads all alike.....65. *Iva.*

Subtribe 3. ZINNIEÆ. Rays pistillate; the tube absent or very short, persistent on achene and at length papery; disk-fls. bisexual, rarely sterile, subtended or embraced by chaffy bracts: lvs. opposite.

A. Receptacle flattish.....66. *Sanvitalia.*
AA. Receptacle conical, cylindrical or elongated.
B. Achenes, at least inner ones, 1–3-awned.....67. *Zinnia.*
BB. Achenes without pappus.....68. *Heliopsis.*

Subtribe 4. VERBESINEÆ. Rays pistillate, or neutral, becoming papery and persistent; disk-fls. bisexual; anthers often blackish: achenes various, but those of disk never obcompressed: pappus various.

A. Chaff of receptacle permanently investing achenes as an accessory covering.....69. *Sclerocarpus.*
AA. Chaff of receptacle concave or complicate, loosely embracing or subtending the disk-achenes, mostly persistent.
B. Rays sometimes absent. Certain species of..70. *Spilanthes.*
BB. Rays usually present.
C. Receptacle high, from conical to columnar or subulate, at least in fr.
D. The rays, if present, pistillate.....70. *Spilanthes.*
DD. The rays sterile.
E. Color of rays rose or rose-purple....71. *Echinacea.*
EE. Color of rays yellow or partly brown-purple (sometimes wholly so).
F. Achenes 4-angled, prismatic.....72. *Rudbeckia.*
FF. Achenes short and broad, compressed.....73. *Lepachys.*
CC. Receptacle low, flat to convex, rarely becoming conical.
D. Achenes not winged nor very flat, when flattened not margined nor sharp-edged.
E. Rays pistillate.....74. *Balsamorhiza.*
EE. Rays sterile.
F. Achenes pubescent.....75. *Viguiera.*
FF. Achenes glabrous.....76. *Helianthus.*
DD. Achenes of the ray or margin often triquetrous, of the disk either flat-compressed and margined or thin-edged, or if turgid some of them winged.
E. Rays neutral.
F. Pappus 0, or an awn or its rudiment answering to each margin of the wingless achene....77. *Encelia.*
FF. Pappus of delicate squamellæ between the 2 chaffy teeth or awns which surmount the 2 acute margins of the achene.....78. *Helianthella.*
FFF. Pappus of 2 slender-subulate naked awns, at length divergent, sometimes with 2 or 3 intermediate awns.....79. *Actinomeris*
EE. Rays pistillate, rarely neutral in Verbesina.
F. Pappus of ∞ distinct squamellæ....80. *Pascalia.*
FF. Pappus of dilated awns or 2 awn-like paleæ on the angles of the achene, with 2 small intermediate squamellæ on each side.....81. *Podachænium.*
FFF. Pappus of 2 awns, sometimes 1–3 or 0, and no intermediate squammellæ.....82. *Verbesina.*

Subtribe 5. COREOPSIDEÆ. Rays pistillate or neutral; disk-fls. fertile; receptacle chaffy; chaff flat or hardly concave: achenes more or less dorsally compressed, often 2-awned.

A. Involucral bracts distinct, the outer herbaceous, inner somewhat like paleæ..... 83. *Guizotia.*
AA. Involucre double; inner bracts membranous, subequal, connate at base or often higher; outer bracts few and small or minute.
B. Planta are all climbers with pistillate rays, achenes much enlarging and sterile disk-fls. with individed style..... 84. *Hidalgoa.*
BB. Plants not climbing: rays usually sterile.
C. Style-branches with long hairy appendages..... 85. *Dahlia.*
CC. Style-branches truncate, penicillate or with short appendages.
D. Bracts of inner involucre united into a cup..... 86. *Thelesperma.*
DD. Bracts of involucre distinct, or united only at the common base.
E. Achenes beaked, slender: rays purple or rose, in 1 species yellow; white vars. in cult.: awns mostly deciduous..... 87. *Cosmos.*
EE. Achenes not beaked: rays yellow or white.
F. Tube of disk-fl. without ring at top.
O. Lvs. or divisions entire..... 88. *Coreopsis.*
OO. Lvs. or divisions serrate..... 89. *Bidens.*
FF. Tube of disk-fls. with a ring near the top..... 90. *Leptosyne.*

Subtribe 6. GALINSOGEÆ. Heads rayless and homogamous (in Marahallia). Pappus of ∞ distinct paleæ..... 91. *Marshallia.*

Subtribe 7. MADIEÆ. Rays pistillate, each subtended by an involucral bract which partly or completely incloses its achene; disk-fls with both stamens and styles, but some or all sterile: glandular, viscid and heavy-scented herbs.

A. Achenes laterally compressed..... 92. *Madia.*
AA. Achenes not laterally compressed..... 93. *Layia.*

7. Helenium Tribe.

A. Involucral bracts united nearly throughout into an oblong cup or tube..... 94. *Tagetes.*
(See also Lasthenia.)
AA. Involucral bracts hardly at all imbricated; when broad, nearly equal or in 1 series.
B. Receptacle mostly high-conical, and acute, beset after the achenes have fallen by projecting points (as if pedicela on which they were inserted).
C. The involucre a single series of bracts connate by their edges into a 5–15-toothed green cup..... 95. *Lasthenia.*
CC. The involucre of loose, distinct bracts..... 96. *Bæria*
(Also Actinolepis coronaria.)
BB. Receptacle flat or convex, rarely obtusely conical: achenes from linear to obpyramidal, rarely 5-angled. (See also BBB.)
C. Herbage mostly woolly: involucral bracts erect, not membranous..... 97. *Eriophyllum.*
CC. Herbage usually not woolly.
D. Disk-fls. deeply 5-cleft: involucral bracts mostly appressed..... 98. *Polypteris.*
DD. Disk-fls. with long and narrow throat and 5 short lobes or teeth.
E. Heads solitary..... 99. *Hulsea.*
EE. Heads paniculate or corymbose.
F. Plants tomentose herba, the lvs. dissected.
O. Involucral bracts free, narrow..100. *Chænactis.*
OO. Involucral bracts connected at the base, broad and obtuse....101. *Bahia.*
FF. Plants not tomentose, the lvs. not dissected.....102. *Pericome.*
BBB. Receptacle from convex to oblong: achenes short, obpyramidal or top-shaped, 5–10-ribbed or angled, mostly silky hairy: disk-fls. all fertile.
C. The receptacle destitute of awn-like fimbrillæ among the fls.
D. Involucre erect or nearly so.....103. *Actinella.*
DD. Involucre spreading or soon reflexed....104. *Helenium.*
CC. The receptacle beset with bristle-like or awl-shaped or rarely dentiform fimbrillæ among the fls.....105. *Gaillardia.*

8. Anthemis Tribe.

A. Receptacle chaffy.
B. Heads usually discoid.
C. Shrubs with small, closely clustered lvs...106. *Erioceph-*
CC. Herbs, or sometimes slightly shrubby. *[alus.*
D. Corolla with a hood-like appendage at base.....107. *Santolina.*
DD. Corolla without such appendage.....108. *Lonas.*

BB. Heads usually radiate.
C. Achene compressed, with 2 narrow margins....109. *Achillea.*
CC. Achenes 4–5-cornered or ∞-ribbed.
D. The heads peduncled at tips of branches.110. *Anthemis.*
DD. The heads sessile in forks, surrounded by 5–6 dissected floral lvs.....111. *Cladanthus.*
AA. Receptacle naked or alveolate-fimbrilliferous.
B. Involucral bracts in many series.
C. Rays present....112. *Chrysanthemum.*
(Consult also Pyrethrum.)
CC. Rays absent....113. *Tanacetum.*
BB. Involucral bracts in 1 or 2 or few series.
C. Rays present....114. *Matricaria*
CC. Rays absent or inconspicuous.
D. Involucre top-shaped....115. *Cenia.*
DD. Involucre ovoid or broadly bell-shaped.116. *Artemisia.*

9. Senecio Tribe.

A. Involucral bracts in 1 series and connate at the base or beyond the middle in a cup; no outer bracts; style-branches of the fertile bisexual fls. truncate at apex, usually penicillate.
B. Style undivided; disk-fls. sterile....117. *Othonna.*
BB. Style bifid; disk-fls. all or some fertile....118. *Gamolepis.*
AA. Involucral bracts in 1 or 2 series, not connate in a cup but free, at least finally.
B. Style-branches of hermaphrodite fertile fls. roundish obtuse or at least not truncate and wholly without appendage or hairiness at summit.
C. Heads composed entirely of bisexual and fertile fls., homogamous, discoid....119. *Cacaliopsis.*
CC. Heads submonœcious or subdiœcious, the fls. containing both stamens and pistils, sterile.
D. The heads radiate, yellow....120. *Tussilago.*
DD. The heads discoid, purplish or white.
E. Style of hermaphrodite fls. undivided; heads several....121. *Petasites.*
EE. Style branched; heads 2....122. *Homogyne.*
BB. Style-branches (of hermaphrodite fls.) either truncate or capitellate at summit, which is either penicillate, hairy or naked and not rarely bears a short conical or flattened appendage.
C. Bracts of involucre herbaceous, acuminate.
D. Receptacle flat....123. *Arnica.*
DD. Receptacle hemispherical....124. *Doronicum.*
CC. Bracts of involucre narrow, strict, usually ribbed or keeled.
D. Apex of style usually truncate and penicillate.
E. Involucral bracts numerous.
F. Achenes subterete....125. *Senecio.*
FF. Achenes dorsally compressed....126. *Cineraria.*
EE. Involucral bracts few, 4–5; heads homogamous....127. *Tetradymia.*
DD. Apex of style with long, subulate hairy appendages; heads homogamous....128. *Gynura.*
DDD. Apex of style with appendages short and obtuse, or long and acutish; heads homogamous....129. *Emilia.*

10. Calendula Tribe.

A. Achenes of the rays thick, hard and bony; those of the disk usually all empty....130. *Osteospermum.*
AA. Achenes straight, those of the rays usually triquetrous; disk-achenes often flattish or 2-winged....131. *Dimorphotheca.*
AAA. Achenes incurved, heteromorphous....132. *Calendula.*

11. Arctotis Tribe.

A. Involucral bracts free, the inner ones broadly scarious, at least at the apex.
B. Herbs glabrous or pubescent: receptacle chaffy....133. *Ursinia.*
BB. Herbs tomentose: receptacle naked or alveolate.
C. Achenes usually villous, crowned by hyaline paleæ which are often convolute....134. *Arctotis.*
CC. Achenes glabrous, with or without a crown of minute paleolæ....135. *Venidium.*
AA. Involucral bracts grown together at the base: lvs. not spinescent: alveoli short....136. *Gazania.*

12. Mutisia Tribe.

A. Rays in 1–2 series, 2-lipped....137. *Gerbera.*
AA. Rays in 2–3 series, the outer always strap-shaped....138. *Chaptalia.*

13. Cichorium Tribe.

A. Pappus 0, or of 2–3 long bristles, which soon fall away....139. *Scolymus.*
AA. Pappus paleaceous or partly so, or aristiform, or plumose.
B. Involucre of equal bracts and no short calyculate ones at base.
C. Achenes long-beaked....140. *Tragopogon.*
CC. Achenes truncate....141. *Krigia.*
BB. Involucre either calyculate or imbricate, i. e., principal bracts equal and some short ones at base, or less unequal bracts in 2 or more series.
C. Achenes (at least inner ones) tapering into a beak.
D. Receptacle with membranous chaff....142. *Hypochœris.*
DD. Receptacle naked....143. *Leontodon.*
CC. Achenes usually short, with summit truncate or only a trifle contracted below apex.
D. Receptacle chaffy....144. *Catananche.*
DD. Receptacle not chaffy.
E. Fls. normally blue....145. *Cichorium.*
EE. Fls. yellow....146. *Scorzonera.*
AAA. Pappus of capillary bristles that are scabrous, rarely barbellulate, never plumose nor paleaceous-dilated: receptacle naked (except in 1 species of Troximon).
B. Achenes flattened: pappus of copious fine soft capillary bristles.
C. The achenes distinctly beaked....147. *Lactuca.*
CC. The achenes beakless....148. *Sonchus.*
BB. Achenes not flattened: pappus persistent or bristles tardily falling (except 1 or 2 species of Crepis).
C. Beak distinct and slender (except in 1 or 2 species of Troximon).
D. The achenes 10-ribbed or 10-nerved, not muricate....149. *Troximon.*
DD. The achenes 4–5-ribbed or angled, muricate....150. *Taraxacum.*
CC. Beak 0, or achene merely narrow at apex.
D. Fls. whitish or cream-color to violet or rose-red....151. *Prenanthes.*
DD. Fls. mostly yellow, sometimes orange-red or white.
E. Pappus of rather rigid, scabrous, fragile bristles which are usually rather dirty or neutral-colored....152. *Hieracium.*
EE. Pappus of copious white and usually soft capillary bristles....153. *Crepis.*

The following genera (and others) also are briefly treated: Amellus, Asterlinosyris, Bellium, Cacalia, Calimeris, Celmisia, Chamæmelum, Cotula, Cryptostemma, Erlangea, Euryops, Gymnolomia, Haplocarpha, Kuhnia, Leptocarpha, Montanoa, Oldenburgia, Pertya, Psilostrophe, Pteronia, Saussurea, Tithonia, Tolpis, Tricholepis, Wedelia and Zaluzania.

107. CAMPANULACEÆ.

A. Fls. irregular, rarely nearly regular; anthers united.
B. Corolla open down to the base on one side.... 1. *Lobelia.*
BB. Corolla with a closed tube.
C. Stamens in a tube free from the corolla.... 2. *Downingia.*
CC. Stamens more or less adnate to the corolla up to near the throat, then monadelphous and free or farther adnate on one side only.... 3. *Palmerella.*
CCC. Stamens affixed at top of corolla-tube or above the middle: caps. 2-valved at apex.... 4. *Isotoma.*
CCCC. Stamens affixed at base of corolla-tube.
D. Fr. an indehiscent berry.... 5. *Centropogon.*
DD. Fr. a caps., 2-valved at apex.... 6. *Siphocampylus*
AA. Fls. regular or nearly so; anthers usually separate.
B. Fr. an indehiscent, fleshy berry.
C. Ovary inferior.... 7. *Canarina.*
CC. Ovary superior as to calyx but not corolla. 8. *Campanumæa.*
BB. Fr. a caps.
C. Caps. dehiscing loculicidally by apical valves.
D. Corolla 5-parted nearly to base.... 9. *Jasione.*
DD. Corolla broadly bell-shaped, 5-lobed.... 10. *Platycodon.*
DDD. Corolla narrowly (or not broadly) bell-shaped or tubular.
E. Calyx-tube adnate, hemispherical.... 11. *Codonopsis.*
EE. Calyx-tube free, long-campanulate or inflated.... 12. *Cyananthus.*
CC. Caps. closed at apex, dehiscing laterally between the ribs by small lids or small solitary valves.
D. Corolla 5-cut-lobed, or -parted.
E. Ovary linear or narrowly oblong.... 13. *Specularia.*

EE. Ovary hemispherical or top-shaped.
F. Anthers connate in a tube.....14. *Symphyandra.*
FF. Anthers not connate in a tube.
G. Style girt at base by an epigynous fleshy disk, which is cup-shaped or tubular.....15. *Adenophora.*
GG. Style without such disk.
H. Corolla 5-parted to the base; lobes narrow, either long-cohering above or rotate-spreading.....16. *Phyteuma.*
HH. Corolla 5-cut shortly or to the middle, rarely farther, bell-shaped, tubular, funnel-shaped or subrotate.....17. *Campanula.*
DD. Corolla narrowly tubular, shortly 3-cut at apex.....18. *Trachelium.*
DDD. Corolla usually 7–10-cut, rarely 5-cut.
E. Number of lobes 5–9, usually 7; fls. bell-shaped.....19. *Ostrowskia.*
EE. Number of lobes 8–10, lobes narrow and spreading.....20. *Michauxia.*

Githopsis, Leptocodon and Lightfootia are also mentioned in the Cyclopedia.

108. MONOTROPACEÆ.

In cultivation..... *Sarcodes.*

109. CLETHRACEÆ.

The only genus..... *Clethra.*

110. PYROLACEÆ.

A. Style very short, obconical: sts. leafy..... 1. *Chimaphila.*
AA. Style mostly elongated; scape naked or leafy only at base.
B. Fls. solitary..... 2. *Moneses.*
BB. Fls. racemose..... 3. *Pyrola.*

111. ERICACEÆ (Inc. Vacciniaceæ).

Subfamily 1. VACCINIEÆ. Ovary inferior: fr. a berry or drupe.

Subfamily 2. ERICINEÆ. Ovary superior: fr. a caps., except in Tribe 1 of Subfamily 2.

Fr. fleshy, a berry or drupe..... 1. ARBUTUS TRIBE.
Fr. a loculicidal caps., chiefly 5-celled: corolla deciduous..... 2. ANDROMEDA TRIBE.
Fr. a caps., with loculicidal or sometimes septicidal dehiscent and 4 or 5 cells: corolla marcescent persistent..... 3. ERICA TRIBE.
Fr. a septicidal caps.: corolla deciduous... 4. RHODODENDRON TRIBE.

Subfamily 1. VACCINIEÆ.

A. Corolla tubular or cylindric; filaments connate or free.
B. Filaments connate or cohering; anthers produced into a single long beak.
C. Stamens shorter than corolla..... 1. *Macleania.*
CC. Stamens equaling or exceeding the corolla. 2. *Thibaudia.*
BB. Filaments distinct; anthers ending in 2 long beaks..... 3. *Agapetes.*
AA. Corolla campanulate, urceolate or rotate; filaments usually free.
B. The ovary wholly inferior.
C. Ovary 10-celled, 10-ovuled..... 4. *Gaylussacia.*
CC. Ovary 4–5-celled, or by false partitions from the back of these cells, 8–10-celled; ovules numerous..... 5. *Vaccinium.*
BB. The ovary at first a third to half superior.... 6. *Chiogenes.*

Subfamily 2. ERICINEÆ.

1. Arbutus Tribe.

A. The anthers have a pair of awns on the back.
B. Ovary-cell many-ovuled..... 7. *Arbutus.*
BB. Ovary-cells 1-ovuled.
C. Nutlets coalescent: lvs. persistent, entire.. 8. *Arctostaphylos.*
CC. Nutlets distinct: lvs. deciduous, serrate... 9. *Arctous.*
AA. The anthers awnless on back.....10. *Pernettya.*

2. Andromeda Tribe.

A. Anther-cells opening through their whole length, not appendaged; stigma 5-lobed, the lobes adnate to a surrounding ring or cup.....11. *Epigæa.*
AA. Anthers opening only at the top; stigma usually entire.
B. Calyx becoming fleshy in fr., forming a berry and inclosing the small caps.....12. *Gaultheria.*
BB. Calyx unchanged and dry under the caps.
C. Sepals or calyx-lobes valvate or open in the bud, never overlapping.
D. The anthers destitute of appendages or awns.....13. *Lyonia.*
DD. The anthers awned.
E. The anthers short and obtuse, with 2 pores topped by slender, ascending awns; corolla urn-shaped.....14. *Andromeda.*
EE. Anthers lanceolate, produced into 2 small tubes, each surmounted by a pair of slender, ascending awns; corolla bell-shaped.....15. *Zenobia.*
EEE. Anthers with 2 spreading or deflexed awns or teeth, on the back of the filament or at its junction with the anther.....16. *Pieris.*
CC. Sepals or calyx-lobes imbricated, at least in the early bud.
D. Lvs. heath-like, small, thick or needle-like, mostly overlapping: anther fixed near apex.....17. *Cassiope.*
DD. Lvs. not heath-like, usually larger, flat, broad and leathery.
E. Corolla cylindraceous to conical-urceolate; anthers fixed near base.
F. Seeds imbricated in 2 rows.....18. *Chamædaphne.*
FF. Seeds pendulous or in all directions.....19. *Leucothoë.*
FFF. Seeds all ascending or erect.....20. *Oxydendrum.*
EE. Corolla bell-shaped or urn-shaped....21. *Enkianthus.*

3. Erica Tribe.

A. Anthers 2-awned on back at base.....22. *Calluna.*
AA. Anthers 2-parted, blunt or awned, usually cristate or lamellate at base.....23. *Erica.*
AAA. Anthers blunt on back, not cristate.....24. *Bruckenthalia*

4. Rhododendron Tribe.

A. Corolla polypetalous or nearly so.
B. Fls. in elongated racemes or panicles: lvs. deciduous.
C. Petals 4; stamens 8.....25. *Elliottia.*
CC. Petals 3; stamens 6.....26. *Tripetaleia.*
BB. Fls. solitary; petals 5; stamens 10: lvs. deciduous.....27. *Cladothamnus.*
BBB. Fls. in umbel-like racemes; petals 5; stamens 5–10: lvs. evergreen.
C. Lvs. tomentose below: caps. 5-celled; seeds winged.....28. *Ledum.*
CC. Lvs. glabrous: caps. 2–3-celled; seeds angular.....29. *Leiophyllum.*
AA. Corolla gamopetalous.
B. Seeds compressed, winged: corolla slightly irregular; stamens 5–10.
C. Stamens usually exserted; anthers opening by a round terminal pore; corolla rotate, campanulate or funnelform.....30. *Rhododendron.*
CC. Stamens included; anthers opening by an oblique pore; corolla urceolate: lvs. deciduous.....31. *Menziesia.*
BB. Seeds subglobose or trigonous, not winged: corolla regular.
C. Stamens 10.
D. The corolla cup-shaped with 10 pouches receiving the anthers; fls. in corymbs or solitary.....32. *Kalmia.*
DD. The corolla rotate; fls. terminal, 1–3: lvs. oblong-elliptic, ciliate.....33. *Rhodothamnus.*
DDD. The corolla urceolate or campanulate; fls. terminal, solitary or in umbels: lvs. heath-like.....34. *Phyllodoce.*
CC. Stamens 5 or 8.
D. Fls. 5-merous, in umbels, 2–5; corolla broadly funnelform: lvs. elliptic, opposite, smooth.....35. *Loiseleuria.*
DD. Fls. 4-merous: lvs. alternate.
E. Corolla rotate, 4-parted; fls. 2–10, in loose racemes: lvs. heath-like.....36. *Bryanthus.*
EE. Corolla campanulate-urceolate with short 4-toothed limb; fls. in loose racemes: lvs. tomentose below.....37. *Dabœcia.*

The genus Pentapterygium is included in the work.

112. EPACRIDACEÆ.

Style inserted in the intruded vertex of the ovary; stamens epipetalous; anthers 1-celled; corolla-lobes quincunciately imbricate; bracts numerous, passing into sepals..... *Epacris.*

The recent genus Rupicola is also mentioned in the work.

113. DIAPENSIACEÆ.

A. Corolla persistent; staminodes 0.
B. Fls. sessile ... 1. *Pyxidanthera.*
BB. Fls. pedunculate ... 2. *Diapensia.*
AA. Corolla deciduous; staminodes 5.
B. Staminodes small, scale-like, separate; corolla-lobes crenate ... 3. *Shortia.*
BB. Staminodes long, linear, separate; corolla-lobes fimbriate ... 4. *Schizocodon.*
BBB. Staminodes spatulate, connate with stamens; corolla-segms. entire ... 5. *Galax.*

114. PLUMBAGINACEÆ.

A. Calyx-limb usually spreading, scarious and colored.
B. Lvs. usually needle-like: styles distinct at angles of ovary; stigmas sub-capitate ... 1. *Acantholimon.*
BB. Lvs. flat: styles as above; stigmas capitate, oblong or linear; infl. cymose or dense or scape 1- to few-fld. ... 2. *Statice.*
BBB. Lvs. flat or linear-subulate: styles shortly subconnate at vertex of ovary; stigmas linear; scape 1-headed ... 3. *Armeria.*
AA. Calyx-lobes or teeth erect with merely scarious sinuses.
B. Stamens free; calyx glandular ... 4. *Plumbago.*
BB. Stamens adnate to middle of corolla; calyx not glandular ... 5. *Ceratostigma.*

115. PRÍMULACEÆ.

A. Corolla-lobes imbricated in quincunx fashion.
B. Plants aquatic: ovules anatrophous; umbilicus basal ... 1. *Hottonia.*
BB. Plants terrestrial: ovules semi-anatropous; umbilicus ventral.
C. Caps. dehisces by a lid at top ... 2. *Soldanella.*
CC. Caps. dehisces by valves.
D. The corolla-lobes bent back ... 3. *Dodecatheon.*
DD. The corolla-lobes spreading or ascending.
E. Stamens affixed to base of corolla; anthers long-acuminate ... 4. *Cortusa.*
EE. Stamens affixed to corolla-tube; anthers obtuse.
F. Corolla-tube usually longer than calyx.
G. Caps. many-seeded ... 5. *Primula.*
GG. Caps. 1–2-seeded ... 6. *Douglasia.*
FF. Corolla-tube as long as calyx or shorter: caps. few or many-seeded ... 7. *Androsace.*
AA. Corolla-lobes convolute in the bud: ovules semi-anatropous; umbilicus ventral.
B. Caps. circumscissile ... 8. *Anagallis.*
BB. Caps. longitudinally dehiscent by valves.
C. Lobes of corolla bent back ... 9. *Cyclamen.*
CC. Lobes of corolla not bent back.
D. Corolla-lobes 5–6: testa of seed with a firm epidermis.
E. Staminodes 0 ... 10. *Lysimachia.*
EE. Staminodes 5, each corolla-lobe curved around its stamen ... 11. *Steironema.*
EEE. Staminodes 5, tooth-like; corolla-lobes not encircling stamens ... 12. *Naumbergia.*
DD. Corolla-lobes usually 7: testa of seed with a lax epidermis ... 13. *Trientalis.*

The genus Glaux may be met with occasionally in cultivation.

116. MYRSINACEÆ.

A. Staminodes 5; corolla gamopetalous.
B. Corolla cylindrical, shortly 5-lobed: fr. many-seeded ... 1. *Theophrasta.*
BB. Corolla subrotate, deeply 5-parted: fr. 1- to many-seeded ... 2. *Clavija.*
BBB. Corolla rotate-campanulate, deeply 5-cut: fr. few-seeded ... 3. *Jacquinia.*
AA. Staminodes 0; corolla gamopetalous or polypetalous: fr. 1-seeded.
B. Corolla imbricated; fls. fascicled, lateral or axillary ... 4. *Myrsine.*
BB. Corolla convolute; panicles terminal or terminal and axillary ... 5. *Ardisia.*

The genus Mæsa is also accounted for.

117. SYMPLOCACEÆ.

The only genus ... *Symplocos.*

118. STYRACACEÆ.

A. Fr. superior, globular or ovoid, not ribbed nor winged ... 1. *Styrax.*
AA. Fr. inferior, elongated ribbed, or winged.
B. Infl. paniculed, many-fld., drooping, subterminal ... 2. *Pterrostyrax.*
BB. Infl. of few-fld. fascicles, often lateral ... 3. *Halesia.*

119. SAPOTACEÆ.

A. Corolla-lobes, calyx-segms., stamens and staminodes (when present) isomerous.
B. Staminodes 0: seeds usually albuminous: fls. 5-merous, rarely 6–7-merous ... 1 *Chrysophyllum.*
BB. Staminodes small, usually affixed higher than stamens, sometimes few or 0: seeds not albuminous: fls. 4–5-merous ... 2. *Lucuma.*
BBB. Staminodes alternate with stamens, rarely affixed higher; seeds albuminous ... 3. *Sideroxylon.*
AA. Corolla-lobes and calyx-segms. isomerous: stamens twice as many or more ... 4. *Isonandra.*
AAA. Corolla-lobes usually 2 or 3 times as many as calyx-segms.
B. Calyx-segms. 1 series ... 5. *Bumelia.*
BB. Calyx-segms. 2 series ... 6. *Mimusops.*

The genus Pouteria is now described in this family.

120. EBENACEÆ.

A. The fls. usually hermaphrodite; stamens in 1 series ... 1. *Royena.*
AA. The fls. dicœcious.
B. Fls. usually 3-merous; stamens 3–∞, commonly 9; ovary 3- or 6-celled ... 2. *Maba.*
BB. Fls. usually 4–5-merous; stamens 4–8, usually in 2 series; ovary 4- or 8-celled ... 3. *Diospyros.*

121. OLEACEÆ.

Fr. didymous or septicidally divisible into two: corolla-lobes strongly imbricate: ovules laterally affixed near base; seeds erect, without endosperm; radicle inferior ... 1. JASMINE TRIBE.
Fr. terete or compressed parallel to the septum, loculicidally dehiscent; ovules pendulous from apex of cells; seeds winged, pendulous; radicle superior ... 2. LILAC TRIBE.
Fr. entire, dry, indehiscent, winged, a samara, compressed contrary to the septum; ovules twin, pendulous from apex of cell; seeds pendulous with endosperm; radicle superior ... 3. ASH TRIBE.
Fr. fleshy and indehiscent, a drupe or rarely a berry, not lobed; ovules twin, laterally affixed near the apex; seeds solitary, suspended or pendulous, with endosperm; radicle superior ... 4. OLIVE TRIBE.

1. Jasmine Tribe.

Fr. fleshy, indehiscent, didymous or by abortion simple ... 1. *Jasminum.*

2. Lilac Tribe.

A. Corolla-lobes imbricate.
B. Ovules 3–4 in a cell: lvs. pinnate and fls. white: corolla-lobes shorter than tube ... 2. *Nathusia.*
BB. Ovules 4–10 in a cell: lvs. entire or 3-foliolate and fls. yellow: lobes many times longer than tube ... 3. *Forsythia.*
AA. Corolla-lobes induplicate-valvate; tube long or short: ovules 2 in a cell; seeds albuminous. 4. *Syringa.*

3. Ash Tribe.

A. Lvs. usually pinnate: fr. elongate, with a terminal wing, generally 1-seeded by abortion ... 5. *Fraxinus.*
AA. Lvs. undivided: fr. ovate or orbiculate, surrounded by a wing, usually 2-celled and 2-seeded ... 6. *Fontanesia.*

4. Olive Tribe.

A. Corolla of nearly distinct petals which are long and linear ... 7. *Chionanthus.*
AA. Corolla-lobes imbricate, broad and obtuse.
B. Endocarp of drupe thinly crustaceous ... 8. *Phillyrea.*
BB. Endocarp of drupe hard and somewhat woody ... 9. *Osmanthus.*
AAA. Corolla-lobes induplicate-valvate.

B. Fr. a drupe; endocarp hard, thick or thin: infl. axillary, rarely terminal.....10. *Olea.*
BB. Fr. a berry, hardly drupaceous; endocarp membranous or thinly coriaceous: panicles terminal.....11. *Ligustrum.*

122. LOGANIACEÆ.

A. Style 2-fid, branches linear, 2-fid..... 1. *Gelsemium.*
AA. Style simple.
B. Corolla-lobes valvate.
C. Fr. a circumscissile caps..... 2. *Spigelia.*
CC. Fr. an indehiscent drupe or berry..... 3. *Strychnos.*
BB. Corolla-lobes imbricate.
C. Anthers exserted..... 4. *Chilianthus.*
CC. Anthers included..... 5. *Buddleia.*

The genus Logania may afford cultivated plants now and then.

123. GENTIANACEÆ.

A. Lvs. alternate or radical.
B. Fr. indehiscent..... 1. *Nymphoides.*
BB. Fr. dehiscent.
C. Caps. usually 4-valved at apex..... 2. *Villarsia.*
CC. Caps. irregularly sub-2-valved at apex.... 3. *Menyanthes.*
AA. Lvs. opposite.
B. Ovary perfectly 2-celled; placentæ solitary in each cell, often thick, adnate to septum; liberated by dehiscence of caps..... 4. *Exacum.*
BB. Ovary 1-celled; placentiferous margins of carpels more or less intruded within or even touching but not connate in the middle of the cell, spuriously 2-celled.
C. Style often deciduous; anthera usually erect.
D. Anthers spirally twisted finally..... 5. *Erythræa.*
DD. Anthers finally recurved at apex..... 6. *Sabbatia.*
CC. Style usually persistent; anthers versatile, finally recurved..... 7. *Lisianthus.*
BBB. Ovary 1-celled; margins of carpels rarely intruded; ovules and seeds affixed at each side of the suture in 1 series or more or less extended over the parietal surface; placentæ adnate, very thin.
C. Corolla has 1–2 pits at base of each lobe.
D. Style short or scarcely any..... 8. *Swertia.*
DD. Style subulate..... 9. *Frasera.*
CC. Corolla has no such pits.....10. *Gentiana.*

The genus Chironia may also be expected in cultivation.

124. ASCLEPIADACEÆ.

Subfamily 1. PERIPLOCEÆ. Pollen granular, loosely aggregated in 2 masses in each anther-cell.

Character of subfamily..... 1. PERIPLOCA TRIBE.

Subfamily 2. EUASCLEPIADEÆ. Pollen waxy, the masses solitary in each anther-cell.

Anthers tipped by a membrane, which is inflexed or sometimes erect, and usually hyaline, rarely opaque or petal-like; pollen-masses suspended, attached in pairs (1 in each adjacent cell of different anthers) to the corpuscle or gland..... 2. CYNANCHUM TRIBE.
Anthers usually tipped by an inflexed or suberect membrane, which is hyaline, rarely opaque; pollinia solitary in each cell, erect or very small..... 3. MARSDENIA [TRIBE.
Anthers obtuse at apex, not appendaged or rarely the connective produced; pollinia solitary in the cells, erect..... 4. CEROPEGIA TRIBE.
Anthers like those of the Ceropegieæ or more incumbent above the top of the stigma or subimmersed: sts. thick and fleshy, leafless or with a few lvs. at top.. 5. STAPELIA TRIBE.
Anthers broad at the top, without appendages or more or less membranaceous on the margins, the cells somewhat transversely dehiscent, attached nearly or quite on the margin of the stigma-disk; pollinia horizontal or essentially so..... 6. GONOLOBUS TRIBE.

1. Periploca Tribe.

A. Scales of corona distant from staminal tube.
B. Corolla-tube short; scales linear or club-shaped..... 1. *Cryptolepis.*
BB. Corolla large, funnel-shaped; scales acuminate or 2-fid..... 2. *Cryptostegia.*
AA. Scales of corona close to stamens.
B. Corolla-lobes valvate..... 3. *Chlorocodon.*
BB. Corolla-lobes imbricate..... 4. *Periploca.*

2. Cynanchum Tribe.

A. The outer or single crown either simple and composed of 5 scales or ring-shaped, adnate to the corolla and not the staminal tube, or rarely adherent to both.
B. Stigma depressed..... 5. *Macroscepis.*
BB. Stigma umbonate or 2-beaked at apex: corona-scales attached at middle (or below) of corolla-tube..... 6. *Physianthus.*
BBB. Stigma plane or umbonate; corona annular, adnate to corolla..... 7. *Philibertia.*
AA. The crown of 5 scales affixed to base of corolla and staminal tube; caudicles of pollinia appendaged with an erect fuscous tooth..... 8. *Oxypetalum.*
AAA. The crown of 5 scalea which are distinct, affixed or adnate to the staminal tube or the back of the anthera.
B. Scalea concave or hooded with an acute ligula inside..... 9. *Asclepias:*
BB. Scales fleshy, narrow, adnate to stamen-tube, but free and recurved at base.....10. *Calotropis.*
BBB. Scales (5 outer ones) carinate-complicate at base of staminal tube; the 5 scales at the apex of the long staminal tube, short, obtuse, spreading, alternate with anthers..11. *Podostigma.*
AAAA. The outer or single crown affixed to the staminal tube, ring- or cup-shaped, entire, lobed or parted.
B. Corona villous inside.....12. *Morrenia.*
BB. Corona with 5 scales or ligulæ inside.....13. *Cynanchum.*
BBB. Corona naked inside.....14. *Vincetoxi-* [*cum.*
BBBB. Corona of 5 ahort processed opposite anthers and 10 ligulæ alternate with anthera in pairs.....15. *Rothrockia.*

3. Marsdenia Tribe.

A. Corolla-lobes strictly valvate.....16. *Hoya.*
AA. Corolla-lobes usually overlapping dextrorsely.
B. Fls. not pure white, urn- or salver-shaped, small or medium-sized.....17. *Marsdenia.*
BB. Fls. white, salver- or funnel-shaped, large...18. *Stephanotis.*

4. Ceropegia Tribe.

Corona double, affixed to staminal tube.....19. *Ceropegia.*

5. Stapelia Tribe.

Corona double, outer spreading, inner of 5 scales. 20. *Stapelia.*

6. Gonolobus Tribe.

Crown cup-shaped or annular, entire or lobed....21. *Gonolobus.*

Additional genera described in Asclepiadaceæ are: Caralluma, Duvalia, Echidnopsis, Gomphocarpus, Hoodia, Huernia, Micholitzia, Pectinaria, Piaranthus, Raphionacme, Sphaerocodon and Trichocaulon.

125. APOCYNACEÆ.

A. Anther-cells not appendaged at base.
B. Ovary entire (Carissa Tribe); fls. 5-merous.
C. Fr. a 2-valved caps.: ovary 1-celled..... 1. *Allamanda.*
CC. Fr. a berry, indehiscent: ovary 2-celled; cells 1–4-ovuled.
D. Ovules laterly affixed: cymes terminal, few-fid: spines axillary..... 2. *Carissa.*
DD. Ovules erect from base: cymes axillary, dense: spines 0..... 3. *Acokanthera.*
BB. Ovaries 2 to several; style 1 (Plumeria Tribe).
C. Calyx with several glands inside or a ring of hairs.
D. Carpels 2-ovuled..... 4. *Thevetia.*
DD. Carpels many-ovuled..... 5. *Tabernæ-* [*montana.*
CC. Calyx without glands inside.
D. Carpels 2-ovuled.
E. Disk 2-scaled..... 6. *Kopsia.*
EE. Disk cup-shaped or annular..... 7. *Rauwolfia.*
DD. Carpels 6- to many-ovuled.
E. Ovules in 2 series.
F. Disk 0.
G. Seeds truncate..... 8. *Amsonia.*
GG. Seeds winged..... 9. *Gonioma.*
FF. Disk of 2 scales.....10. *Vinca.*
EE. Ovules in many series.
F. Stamens near base of tube.....11. *Plumeria.*
FF. Stamens above middle of tube.....12. *Alstonia.*
AA. Anther-cells produced at base. (Echites Tribe.)
B. The cone of anthers more or less exserted at apex.
C. Throat of corolla with 5 scales.....13. *Prestonia.*
CC. Throat without scales.....14. *Vallaris.*
BB. The anthers included.
C. Lvs. usually in whorls of 3.....15. *Nerium.*

cc. Lvs. opposite.
D. Corolla bell-shaped, with 5 squamellæ alternating with stamens.....16. *Apocynum.*
DD. Corolla salver-shaped or funnel-shaped, the throat without scales.
E. Disk of 2 scales.....17. *Dipladenia.*
EE. Disk many-toothed or crenulate.....18. *Odontadenia.*
EEE. Disk of 5 lobes or scales, often truncate in Trachelospermum.
F. Fls. salver-shaped.
G. Infl. lax corymbose cymes.....19. *Trachelos-*
GG. Infl. racemose; rarely shortly dichotamous.....20. *Echites.* [*permum.*
FF. Fls. funnel-shaped.
G. In cymes.....21. *Beaumontia.*
GG. In racemes.....22. *Mandevilla.*

Other genera treated are: Hunteria, Landolphia, Pachypodium. Parsonsia, Pleiocarpa and Strophanthus.

126. POLEMONIACEÆ.

A. Caps. deeply loculicidal: herbs or sub-shrubs.
B. Stamens unequally affixed to corolla-tube; not declinate.
C. Lvs. mostly opposite, entire..... 1. *Phlox.*
CC. Lvs. mostly alternate, usually incised or pinnatifid..... 2. *Collomia.*
BB. Stamens equally affixed to tube or throat.
C. The stamens not declinate..... 3. *Gilia.*
CC. The stamens declinate.
D. Filaments pilose-appendaged at base... 4. *Polemo-* [*nium.*
DD. Filaments not appendaged..... 5. *Læselia.*
AA. Caps. shortly loculicidal at apex; seeds broadly winged: trees or shrubs..... 6. *Cantua.*
AAA. Caps. deeply septicidal: tall climbers..... 7. *Cobæa.*

127. HYDROPHYLLACEÆ.

A. Styles 2, distinct from base; corolla-lobes imbricate..... 1. *Wigandia.*
AA. Styles 2-cut, rarely undivided.
B. Corolla-lobes usually convolute.
C. Stamens exserted..... 2. *Hydrophyl-* [*lum.*
CC. Stamens included..... 3. *Nemophila.*
BB. Corolla-lobes imbricated.
C. Fls. marcescent, bell-shaped..... 4. *Emmenan-*
CC. Fls. deciduous. [*the.*
D. The peduncles 1-fid..... 5. *Hespero-* [*chiron.*
DD. The fls. cymose or in 1-sided racemes... 6. *Phacelia.*

128. BORAGINACEÆ.

A. Ovary undivided (or only laterally 4-lobed) and surmounted by the style.
B. Style twice bifid; stigmas not annular; cotyledons plaited or corrugated..... 1. CORDIA TRIBE.
BB. Style once bifid or 2-parted (the divisions sometimes coalescent to the top); stigmas more or less capitate; cotyledons plane..... 2. EHRETIA TRIBE.
BBB. Style entire, sometimes wanting; stigma shield- or ring-shaped, forming a complete ring surmounted usually by a tip or appendage which is entire or 2-lobed and varies from hemispherical to subulate..... 3. HELIOTROPE [TRIBE.
AA. Ovary 4-parted (rarely 2-parted) from above into 1-celled, 1-ovuled divisions surrounding the base of the undivided (rarely 2-lobed) style; stigma not annular..... 4. BORAGE TRIBE.

1. Cordia Tribe.

Calyx tubular or bell-shaped, merely toothed or lobed..... 1. *Cordia.*

2. Ehretia Tribe.

Calyx 5-parted; style 2-fid..... 2. *Ehretia.*

3. Heliotrope Tribe.

A. Plants sarmentose or twining..... 3. *Tourne-* [*fortia.*
AA. Plants are herbs or sub-shrubs..... 4. *Heliotro-* [*pium.*

4. Borage Tribe.

A. Gynobase elevated.
B. Apex of nutlets not projecting much beyond scar.
C. Nutlets divergent or divaricate (either radiately or in pairs), extended outward or backward much beyond the insertion (which is by a roundish or oblong scar); gynobase little elevated or broadly conical.
D. Stamens included.
E. Nutlets covered with small cups or cavities..... 5. *Omphalodes.*
EE. Nutlets covered with small warts or barbed bristles..... 6. *Cynoglos-*
DD. Stamens exserted. [*sum.*
E. Corolla-tube longer than spreading lobes..... 7. *Lindelofia.*
EE. Corolla tubular; lobes short, erect or somewhat spreading..... 8. *Solenanthus.*
CC. Nutlets adnate by the inner face or keel to an elevated, conical or columnar gynobase, forming a more or less globose or pyramidal fruit..... 9. *Myosotid-*
BB. Apex of nutlets projecting conspicuously beyond scar. [*ium.*
C. Pedicels persistent.
D. Nutlets keeled toward apex.....10. *Plagiobotrys.*
DD. Nutlets not keeled.....11. *Oreocarya.*
CC. Pedicels deciduous.....12. *Cryptanthe.*
AA. Gynobase flat or nearly so.
B. Scar excavated or often girt by a ring.
C. Throat of corolla has 5 scales inside.
D. Filaments appendaged with a scale.....13. *Borago.*
DD. Filaments not appendaged.
E. Corolla-lobes very short and sub-erect.....14. *Symphytum.*
EE. Corolla-lobes spreading.....15. *Anchusa.*
CC. Throat naked or pilose.....16. *Pulmonaria.*
BB. Scar flat, either small at the inner angle or oblique.
C. Racemes without bracts (rarely a few bracts at base); anthers obtuse at apex.
D. Throat of corolla scaly.....17. *Myosotis.*
DD. Throat almost naked.....18. *Mertensia.*
CC. Racemes bracted.
D. Anthers obtuse at apex or hardly mucronate.
E. Lobes of corolla erect.....19. *Onosmo-*
EE. Lobes of corolla spreading. [*dium.*
F. Corolla-tube cylindrical; throat naked or 5-gibbous and subquamate.....20. *Lithosper-*
FF. Corolla-tube slender; throat naked.....21. *Arnebia.* [*mum.*
FFF. Corolla tubular or salver-form; throat naked, lobes usually unequal.....22. *Echium.*
DD. Anthers linear, often acuminate, arrow-shaped at base.
E. Nutlets distinct.....23. *Onosma.*
EE. Nutlets connate in pairs.....24. *Cerinthe.*

129. CONVOLVULACEÆ.

A. Corolla-lobes small, imbricate: plants parasitic, leafless: sts. thread-like, not green..... 1. *Cuscuta.*
AA. Corolla large, plicate or induplicate in æstivation.
B. Fr. berry-like or harder, indehiscent: style undivided.
C. The ovary 4-celled, 4-ovuled..... 2. *Argyreia.*
CC. The ovary 2-celled, 4-ovuled..... 3. *Lettsomia.*
BB. Fr. a 2–4-valved caps. with a thin or hard pericarp, or indehiscent with a thin pericarp: styles 2 and distinct or the style entire or divided.
C. Stigma capitate; style entire or 2-parted; ovary 2-celled, 4-ovuled..... 4. *Porana.*
CC. Stigma thick, globose, often twin; ovary 2–4-celled, 4-ovuled.
D. Stamens and style included within the corolla-tube..... 5. *Ipomœa.*
DD. Stamens and style exserted.
E. Plant a night-bloomer: corolla contorted in bud..... 6. *Calonyction.*
EE. Plant a day-bloomer: corolla not contorted..... 7. *Quamoclit.*
CCC. Stigma capitate; ovary 2-celled..... 8. *Breweria.*
CCCC. Stigmas 2, linear, filiform or thickish..... 9. *Convolvulus.*
(Except Calystegia section. See also Rhodorhiza.)
CCCCC. Stigmas 2, flat, ovate or oblong.....10. *Jacquemon-* [*tia.*
(Also Calystegia section of Convolvulus.)

130. SOLANACEÆ.

A. Stamens didynamous, the fifth (and sometimes also one of the pairs) smaller, abortive or missing.
B. Number of perfect stamens usually 5.
C. The stamens affixed at middle of tube or lower ... 1. *Petunia.*
CC. The stamens affixed at apex of tube ... 2. *Nierembergia.*
BB. Number of perfect stamens usually 4 or 2.
C. Corolla-tube cylindrical; limb oblique; perfect stamens 2 ... 3. *Schizanthus.*
CC. Corolla obliquely funnel-shaped; perfect stamens 4, didynamous ... 4. *Salpiglossis.*
CCC. Corolla-tube cylindrical, straight; anthers of the 2 short stamens dimidiate, of the longer ones 2-celled ... 5. *Browallia.*
CCCC. Corolla-tube twisted; anthers as in Browallia ... 6. *Streptosolen.*
CCCCC. Corolla-tube long, not twisted, slightly widened at apex; 4 perfect anthers with confluent cells ... 7. *Brunfelsia.*
AA. Stamens all perfect not didynamous, normally 5.
B. Seeds little, if at all, flattened.
C. Fr. a few-seeded berry ... 8. *Cestrum.*
CC. Fr. a many-seeded caps.
D. Corolla with a narrow tube and short spreading lobes ... 9. *Fabiana.*
DD. Corolla funnel- or salver-shaped; limb equal or oblique ... 10. *Nicotiana.*
BB. Seeds flattened.
C. Fr. a caps.
D. Corolla-lobes plicate.
E. Caps. 4-celled, and 4-valved (sometimes indehiscent) ... 11. *Datura.*
EE. Caps. circumscissile above the middle. 12. *Scopolia.*
DD. Corolla-lobes imbricate ... 13. *Hyoscyamus.*
CC. Fr. berry-like, or at least indehiscent.
D. Limb of corolla subequally plicate or divided into valvate or induplicate lobes.
E. Anthera longer than filament, connivent connate in a cylinder or cone, acuminate at apex or dehiscent by 2 apical pores.
F. Connective variously thickened on back ... 14. *Cyphomandra.*
FF. Connective slender or obsolete.
G. The anthers acuminate, hollow at tip, dehiscing by a longitudinal crack ... 15. *Lycopersicum.*
GG. The anthers opening by an apical pore which is sometimes continued into a longitudinal crack ... 16. *Solanum.*
EE. Anthers free, with parallel cells, and dehiscing by a longitudinal crack.
F. Stamens affixed above middle of tube ... 17. *Salpichroa.*
FF. Stamens affixed near the base of tube.
G. Corolla nearly rotate or broadly bell-shaped.
H. Fruiting calyx hardly enlarged ... 18. *Capsicum.*
HH. Fruiting calyx inflated or bladdery.
I. Calyx cut shortly or to middle ... 19. *Physalis.*
II. Calyx parted to base ... 20. *Nicandra.*
GG. Corolla tubular or narrowly funnel-shaped ... 21. *Iochroma.*
DD. Limb of corolla more or less imbricate, flat and distinct or connected by induplicate sinuses.
E. The lobes imbricated from the base, not plicate.
F. Plants woody.
G. Berry with 4 stones, each 1–2-seeded ... 22. *Grabowskia.*
GG. Berry with 2 cells, each 1–∞-seeded ... 23. *Lycium.*
FF. Plants herbaceous ... 24. *Atropa.*
EE. The sinuses of the corolla induplicate between the lobes.
F. Calyx long and tubular ... 25. *Solandra.*
FF. Calyx leafy, 5-fid, increasing in fr. ... 26. *Mandragora.*

131. NOLANACEÆ.

Single genus ... *Nolana.*

132. SCROPHULARIACEÆ.

Series 1. PSEUDOSOLANEÆ. Lvs. all alternate: infl. simple, centripetal; corolla hardly if at all bilabiate; the 2 posterior lobes external in the bud.

A. Corolla-tube short, somewhat bell-shaped: American species ... 1. LEUCOPHYLLUM [TRIBE.
AA. Corolla subrotate: Old World species ... 2. VERBASCUM TRIBE.

Series 2. ANTIRRHINIDEÆ. Lvs. prevailingly opposite, at least the lower: infl. simple or compound, partially centrifugal, i.e., the peduncle cymosely few- to several-fld.; posterior lip or lobes of corolla generally external in the bud.

A. Corolla bilabiate; lips inflated, concave. 3. CALCEOLARIA
AA. Corolla bilabiate or nearly regular; lips nearly plane. [TRIBE.
B. Corolla saccate or spurred.
C. Tube wanting ... 4. HEMIMERIS TRIBE.
CC. Tube present ... 5. ANTIRRHINUM [TRIBE
BB. Corolla-tube not saccate nor spurred.
C. Infl. centrifugal, cymoae, usually compound, rarely sub-simple ... 6. CHELONE TRIBE.
CC. Infl. centripetal.
D. Anthers 1-celled ... 7. MANULEA TRIBE.
DD. Anthers 2-celled ... 8. GRATIOLA TRIBE.

Series 3. RHINANTHIDEÆ. Lvs. various: infl. simple or compound; corolla-lobes variously imbricated, the anterior or lateral ones usually exterior.

A. Anther-cells contiguous at apex and usually confluent: plants not parasitic. 9. DIGITALIS TRIBE.
AA. Anther-cells everywhere distinct: plants often root-parasitic.
B. Corolla-lobes all flat, usually spreading ... 10. GERARDIA TRIBE.
BB. Corolla with posterior lip erect, concave or galeate; anterior lip often spreading ... 11. EUPHRASIA TRIBE.

1. Leucophyllum Tribe.

Corolla-lobes 5, subequal, spreading ... 1. *Leucophyllum.*

2. Verbascum Tribe.

A. Stamens 5 ... 2. *Verbascum.*
AA. Stamens 4 ... 3. *Celsia.*

3. Calceolaria Tribe.

The only genus ... 4. *Calceolaria.*

4. Hemimeris Tribe.

A. Corolla more or less rotate, resupinate, the grooves inconspicuous or obsolete ... 5. *Alonsoa.*
AA. Corolla spread out flat, swollen or saccate under anterior lip ... 6. *Angelonia.*
AAA. Corolla flat or concave, with 2 basal spurs or pouches ... 7. *Diascia.*
AAAA. Corolla-tube short with 1 spur or sac on the anterior side ... 8. *Nemesia.*

5. Antirrhinum Tribe.

A. Throat has a prominent palate.
B. Corolla spurred ... 9. *Linaria.*
BB. Corolla saccate or gibbous at base ... 10. *Antirrhinum.*
AA. Throat has no palate.
B. Caps. opens by 2 apical pores which are sometimes confluent ... 11. *Anarrhinum.*
BB. Caps. opens by transverse holes or irregularly.
C. Calyx ample, membranous ... 12. *Rhodochiton.*
CC. Calyx smaller, herbaceous ... 13. *Maurandia.*

6. Chelone Tribe.

A. Staminode often elongated.
B. Caps. loculicidally dehiscent ... 14. *Tetranema.*
BB. Caps. septicidally dehiscent.
C. Fls. bilabiate.
D. Anterior lip with middle lobe folded upon itself and inclosing the stamens. 15. *Collinsia.*
DD. Anterior lip of 3 flat spreading lobes.
E. Seeds winged ... 16. *Chelone.*
EE. Seed not winged ... 17. *Pentstemon.*
CC. Fls. with all the lobes flat, spreading and subequal ... 18. *Russelia.*
AA. Staminode usually in the form of a scale at apex of corolla-tube ... 19. *Scrophularia.*
AAA. Staminode small, minute or 0.
B. Stamens usually exserted.
C Calyx 5-parted: caps. tardily dehiscent ... 20. *Physelius.*
CC. Calyx cup-shaped: berry indehiscent ... 21. *Halleria.*
BB. Stamens included; calyx 5-cut.
C. Fr. an indehiscent berry ... 22. *Teedia.*
CC. Fr. a loculicidal caps ... 23. *Paulownia.*

7. Manulea Tribe.

A. Calyx bilabiate or 2-parted ... 24. *Zaluzianskya.*
AA. Calyx 5-parted ... 25. *Chænostoma.*

8. Gratiola Tribe.

A. Perfect stamens 2.....26. *Gratiola.*
AA. Perfect stamens 4.
B. Stamens all affixed inside corolla-tube.
C. Calyx bell-shaped, 5-parted.....27. *Mazus.*
CC. Calyx tubular, 5-toothed and -angled.....28. *Mimulus.*
BB. Stamens partly inside corolla-tube, partly in throat, 2 affixed in each place.....29. *Torenia.*

9. Digitalis Tribe.

A. Caps. opens by loculicidal valves.
B. Herbs creeping.....30. *Sibthorpia.*
BB. Herbs upright.....31. *Rehmannia.*
BBB. Herbs thick-rhizomatous, the lvs. nearly or quite radical.....32. *Wulfenia.*
AA. Caps. opens by septicidal valves.
B. Lvs. alternate.
C. Corolla declinate, tube swollen, or bell-shaped; posterior lip spreading.....33. *Digitalis.*
CC. Corolla-tube slender, spreading.....34. *Erinus.*
BB. Lvs. opposite.....35. *Ourisia.*
AAA. Caps. 4-valved or loculicidally 2-valved.
B. Lvs. all alternate or radical.....36. *Synthyris.*
BB. Lvs. (at least lower ones) opposite.....37. *Veronica.*

10. Gerardia Tribe.

Calyx-lobes shorter than tube.....38. *Gerardia.*

11. Euphrasia Tribe.

A. The anther-cells equal.....39. *Pedicularis.*
AA. The outer anther-cell fixed by the middle; inner one pendulous or deficient.
B. Calyx laterally compressed, split on anterior side or both.....40. *Castilleia.*
BB. Calyx 4-cut.....41. *Orthocarpus.*

Other genera to be looked for are: Bowkeria, Craterostigma, Herpestis, Lindenbergia, Seymeria.

133. LENTIBULARIACEÆ.

A. Posterior lip of corolla erect; calyx 2-parted or deeply 2-lobed..... 1. *Utricularia.*
AA. Posterior lip of corolla spreading; calyx 4–5-parted..... 2. *Pinguicula.*

134. BIGNONIACEÆ.

A. Ovary 2-celled: caps. dehiscent: lvs. mostly opposite.
B. Valves opening parallel with septum.
C. Lvs. 2–3-foliolate: shrubs, climbing with tendrils.
D. Tendrils filiform, simple.
E. Disk present.
F. Caps. smooth or slightly warty, broadly linear: calyx with black glands..... 1. *Adenocalymma.*
FF. Caps. rough, broad: disk crenate; calyx not glandular, with 5 subulate teeth..... 2. *Clytostoma.*
EE. Disk wanting; calyx with 5 short teeth or truncate: caps. linear..... 3. *Cydista.*
DD. Tendrils 3-parted, filiform, slender.
E. Corolla straight or slightly curved, membranous: caps. narrow, smooth.
F. Lobes of corolla imbricate; stamens inclosed: tendrils twice or thrice 3-parted..... 4. *Anisostichus.* (See under Bignonia.)
FF. Lobes valvate; stamens exserted: tendrils simply 3-parted..... 5. *Pyrostegia.*
EE. Corolla strongly curved; calyx leathery, tomentose.
F. Stamens inclosed; fls. white.
G. Ovary warty: caps. broad, rough, not curved: branches angular..... 6. *Pithecoctenium.*
GG. Ovary smooth: caps. oblong, curved, with a convex and a concave valve: branches terete..... 7. *Distictis.*
FF. Stamens exserted; fls. red; ovary tomentose..... 8. *Phædranthus.*
DDD. Tendrils 3-parted, the ramifications hooked, claw-like.
E. Calyx truncate or lobed; disk simple. 9. *Bignonia.*
EE. Calyx splitting on one side; disk double..... 10. *Macfadyenia.*
CC. Lvs. 2–3-pinnate: upright tree..... 11. *Oroxylon.*
BB. Valves opening at right angles to septum: upright plants or climbing without tendrils.
C. Habit climbing (upright in some forms of Campsis): lvs. pinnate.
D. Stamens exserted: lfts. serrate..... 12. *Tecomaria.*
DD. Stamens inclosed.
E. Climbing by rootlets: lfts. serrate: corolla campanulate-funnelform... 13. *Campsis.*
EE. Climbing without rootlets: lfts. entire.
F. Corolla club-shaped, straight, upright; fls. in racemes..... 14. *Campsidium*
FF. Corolla campanulate-funnelform; fls. in panicles..... 15. *Pandorea.*
CC. Habit upright: herbs, with alternate lvs.: caps. folliculately dehiscent.
D. Seeds with membranous wing: lvs. simple or compound..... 16. *Incarvillea.*
DD. Seeds with fringed hairs, lvs. pinnate. 17. *Amphicome.*
CCC. Habit upright: trees or shrubs with usually opposite lvs.
D. Lvs. simple or digitate.
E. Seeds fringed with hairs: lvs. simple, entire.
F. Fertile stamens 4: lvs. linear, alternate..... 18. *Chilopsis.*
FF. Fertile stamens 2: lvs. cordate, opposite..... 19. *Catalpa.*
EE. Seeds winged: lvs. simple or digitate. 20. *Tabebuia.*
DD. Lvs. pinnate, rarely simple and serrate.
E. Septum flat.
F. Calyx campanulate, truncate, toothed or lobed.
G. Staminode not elongated.
H. Anthers with enlarged leafy connective; calyx regularly 5-toothed: shrubs: lfts. serrate; lvs. rarely simple... 21. *Tecoma.*
HH. Anthers without enlarged connective; calyx irregularly 2–5-lobed: tree: lfts. usually entire..... 22. *Heterophragma.*
GG. Staminode much elongated and enlarged at the apex: calyx small; fls. in large terminal panicles: lvs. 1–2-pinnate with numerous lfts..... 23. *Jacaranda.*
FF. Calyx spathe-like, splitting on one side; corolla broadly campanulate..... 24. *Spathodea.*
EE. Septum thick, spongy.
F. Seeds in deep impressions of the septum: calyx truncate or indistinctly toothed: lvs. usually bipinnate..... 25. *Radermachia.*
FF. Seeds in shallow impressions of the septum: calyx 3–5-lobed: lvs. pinnate..... 26. *Stereospermum.*
AA. Ovary 1-celled.
B. Fr. a dehiscent caps.: corolla tubular, narrowed at the mouth: lvs. opposite, pinnate: climbing with tendrils..... 27. *Eccremocarpus.*
BB. Fr. indehiscent: corolla campanulate or campanulate-funnelform: trees or shrubs, with alternate lvs.
C. Lvs. simple or 3-foliolate.
D. Calyx spathe-like, splitting on one side; corolla regular; fls. on the old wood.. 28. *Parmentiera.*
DD. Calyx campanulate, irregularly lobed; corolla very irregular; fls. at the end of the branches..... 29. *Crescentia.*
CC. Lvs. pinnate: corolla irregular..... 30. *Kigelia.*

The genus Colea is also more or less in cultivation within our limits.

135. GESNERIACEÆ.

A. Ovary more or less inferior: fr. capsular.
B. Disk 0..... 1. *Niphæa.*
BB. Disk annular.
C. Fls. smallish, pallid or white..... 2. *Dicyrta.*
CC. Fls. largish, variously colored.
D. Corolla-tube broadly swollen or bell-shaped; calyx-lobes usually membranous or leafy..... 3. *Gloxinia.* (Of botanists, not of florists.)
DD. Corolla-tube cylindrical or broadened above; calyx-lobes narrow or short.
E. The fls. axillary..... 4. *Achimenes.* (Consult also Scheeria.)
EE. The fls. alternate in a terminal, leafless raceme..... 5. *Nægelia.*
BBB. Disk of 5 distinct or but slightly united glands, these equal or unequal.
C. Caps. inferior to the middle or higher.
D. Anther-cells confluent at apex..... 6. *Sinningia.* (Gloxinia of florists.)
DD. Anther-cells distinct..... 7. *Isoloma.*
CC. Caps. shortly immersed at base, almost superior..... 8. *Gesneria.*

AA. Ovary wholly superior: fr. capsular or baccate, unknown in Saintpaulia.
B. Anther-cells distinct and parallel.
C. Disk with a large posterior gland, otherwise small or wanting.
D. Filaments free among themselves..... 9. *Episcia.*
DD. Filaments connate into a sheath which is split on the posterior side.
E. Anthers separate.....10. *Alloplectus.*
EE. Anthers connate cross-like.....11. *Columnea.*
CC. Disk annular, elevated, almost cup-shaped.
D. Perfect stamens 2.....12. *Agalmyla.*
DD. Perfect stamens 4.....13. *Trichos-* [*porum*
CCC. Disk obsolete.....14. *Mitraria.*
BB. Anther-cells divaricate or diverging, rarely sub-parallel.
C. Disk 0.
D. Anthers free.....15. *Ramonda.*
DD. Anthers cohering in a tube extending beyond the cells.....16. *Conandron.*
CC. Disk reduced to a posterior gland.....17. *Codonanthe.*
CCC. Disk a ring (rarely dimidiate in Chirita).
E. Lvs. cauline, opposite.
F. Stamens 4.....18. *Besleria.*
FF. Stamens 2.....19. *Chirita.*
EE. Lvs. basal (rarely opposite in Streptocarpus).
F. Stamens 4.....20. *Haberlæa.*
FF. Stamens 2. [*pus.*
G. Corolla-tube long.....21. *Streptocar-*
GG. Corolla-tube short.....22. *Saintpaulia.*

Additional genera described are: Acanthonema, Boea, Corytholoma, Cyrtandra, Klugia, Lysionotus, Rhabdothamnus and Roettlera.

136. MARTYNIACEÆ.

A. Corolla-tubes swollen above the short base..... 1. *Martynia.*
AA. Corolla-tube very long, slender and cylindrical with a bell-shaped throat..... 2. *Craniolaria.*

137. PEDALIACEÆ.

A. Caps. truncate at apex, the angles awned or horned..... 1. *Ceratotheca.*
AA. Caps. obtuse or acuminate, unarmed..... 2. *Sesamum.*

138. ACANTHACEÆ.

A. Corolla expanded into a single obovate lip.
B. Calyx of normal texture; posterior segms. 3–5-nerved..... 1. *Blepharis.*
BB. Calyx usually cartilaginous; posterior segm. 3-5-nerved..... 2. *Acanthus.*
AA. Corolla with subequal limb, or 2-lipped.
B. The corolla contorted.
C. Ovary with 2 collateral ovules in each cell, or by abortion 1..... 3. *Thunbergia.*
CC. Ovary with 2 to many ovules in each cell, in 1 series or alternately placed one above another.
D. Filaments connate in pairs at the base.
E. Caps. subterete..... 4. *Ruellia.*
EE. Caps. compressed parallel to the septum..... 5. *Dædalacan-* [*thus.*
DD. Filaments equidistant or subconnate at the base in pairs; calyx-lobes obtuse..... 6. *Sanchezia.*
DDD. Filaments crowded or connate at the base on the posterior wall of the tube or 2 posterior filaments affixed a little higher.
E. Calyx ample, membranous or colored. 7. *Whitfieldia.*
EE. Calyx-segms. linear, not colored.
F. Ovules 2 in each cell..... 8. *Strobi-* [*lanthes.*
FF. Ovules 3 to many in each cell..... 9. *Hemigra-* [*phis.*
BB. The corolla not contorted.
C. Corolla of 5 flat lobes, not bilabiate.
D. Stamens 4.
E. The corolla-lobes variously imbricated, lateral ones usually outer.
F. Anthers all 2-celled.....10. *Barleria.*
FF. Anthers all 1-celled.....11. *Crossandra.*
EE. The anterior corolla-lobe outside, posterior one inside.
F. Anthers all 1-celled.....12. *Stenan-* [*drium.*
FF. Anthers all 2-celled (in Chamæranthemum, the posterior anthera sometimes 1-celled).
G. Tube swollen into a long or broad throat.....13. *Asystasia.*
GG. Tube long, slender, scarcely swollen at apex.....14. *Chamær-* [*anthemum.*
DD. Stamens 2: ovules in each cell 2.....15. *Eranthe-* [*mum.*
CC. Corolla bilabiate or sub-equally 4-cut.
D. Ovules in each cell 3 or more.....16. *Phlogacan-* [*thus*
DD. Ovules in each cell 2.
E. Fls. with 2 or 4 bracts longer than calyx.....17. *Peristrophe.*
EE. Fls. without such bracts.
F. Stamens 4, anthers all 1-celled....18. *Aphelandra.*
FF. Stamens 2, anthers 2-celled.
G. Anther-cells unlike, one larger or affixed higher. (In Jacobinia cells often subequal.)
H. The lower anther cell usually spurred.....19. *Justicia.*
HH. The anther-cells not spurred, sometimes equally mucronate at base.
I. The corolla with short tube and ample lips.....20. *Adhatoda.*
II. The corolla-tube usually long and narrow.....21. *Jacobinia.*
GG. Anther-cells equal.
H. Staminodes at base of filaments small.
I. Corolla-tube swollen above; posterior lip incurved, anterior spreading, 3-cut.22. *Graptophyl-* [*lum.*
II. Corolla-tube elongated; limb sub-bilabiate, 4-lobed....23. *Thyrsacan-* [*thus*
HH. Staminodes 0.
I. Veins of lvs. white or colored.24. *Fittonia.*
II. Veins of lva. green.
J. Calyx-segms. linear or bristle-like.....25. *Schaueria.*
JJ. Calyx small; lobes acute or acuminate.....26. *Anisacan-* [*thus.*

The following genera are also treated: Anisotes, Beloperone, Dianthera, Dicliptera, Duvernoia, Dyschoriste, Lepidagathis, Micranthus, Pseuderanthemum, Rungia and Warpuria.

139. GLOBULARIACEÆ, or SELAGINACEÆ.

A. Calyx 5-cut; the 2 posterior lobes of the corolla narrow or connate or deficient..... 1. *Globularia.*
AA. Calyx cut down one side; posterior lobes of corolla 4..... 2. *Heben-* [*streitia.*

140. PHRYMACEÆ.

The only genus..... *Phryma.*

141. MYOPORACEÆ.

Corolla more or less bell-shaped, rarely funnel-shaped, with a subregular limb; ovary 2- or more-celled; cells 1-ovuled, rarely 2-celled and 2-ovuled..... *Myoporum.*

142. VERBENACEÆ.

A. Infl. centripetal.
B. Fls. sessile in the spike.
C. Nutlets 2, or by abortion 1, 1-seeded.
D. Fr. a juicy berry..... 1. *Lantana.*
DD. Fr. drupaceous: calyx 2–4-cut or -toothed..... 2. *Lippia.*
DDD. Fr. dry: calyx 5-toothed..... 3. *Stachytar-* [*pheta*
CC. Nutlets or cells of fr. 4, or by abortion fewer, 1-seeded..... 4. *Verbena.*
BB. Fls. pedicelled.
C. Nutlets 1-seeded.
D. Number of nutlets 4..... 5. *Amasonia.*
DD. Number of nutlets 2 or 1..... 6. *Petræa.*
CC. Nutlets 2-seeded, in pyrenes 2–5, 2-locellate..... 7. *Duranta.*
AA. Infl. centrifugal.
B. Fr. drupe-like, entire or 4-lobed, exocarp usually pulpy or fleshy, the endocarp entire or 4-celled, often separating into 4 nutlets.
C. Corolla regular; stamens as many as petals..... 8. *Callicarpa.*
CC. Corolla-limb oblique, with anterior lobe produced, or sub-bilabiate; stamens 4, didynamous or arched under posterior lobes.
D. Drupe with one 4-celled stone.
E. Corolla-tube cylindrical, short..... 9. *Vitex.*

EE. Corolla-tube strongly dilated above..10. *Gmelina.*
DD. Drupe 4-parted, with 4 stones, or by reduction 1-stoned (this 1-celled).
E. Fertile stamens 2.....11. *Oxera.*
EE. Fertile stamens 4.....12. *Clerodendron.*
BB. Fr. dry, subcapsular; exocarp with 4 valves involute at the margin from the base up, which carry off the nutlets and leave no central column.....13. *Caryopteris.*

Other genera in cultivation in North America are Avicennia, Citharexylum, Congea, Diostea, Faradaya, Premna.

143. LABIATÆ.

I. Summary of Tribes.

Ignoring exceptions.

A. The nutlets fleshy or drupe-like, affixed to a small basal or oblong introrsely oblique areole: ovary 4-lobed. 1. PRASIA TRIBE.
AA. The nutlets dry or hard.
B. Ovary shortly, rarely deeply 4-lobed: nutlets wrinkled or netted, affixed to an obliquely introrse or lateral, usually large, areole.
C. Seeds, when known, with endosperm: corolla with an ample throat and broad lobes..... 2. PROSTANTHERA TRIBE.
CC. Seeds without endosperm: corolla various..... 3. AJUGA TRIBE.
BB. Ovary 4-parted to the base: nutlets affixed to a small basal or slightly oblique areole.
C. Stamens declinate; perfect ones 4, rarely 2; anthers 1-celled by confluence..... 4. OCIMUM TRIBE.
D. Subtribe 1. EUOCIMEÆ. Areole basal; stamens usually exserted; anterior corolla-lobe usually unlike the others.
DD. Subtribe 2. LAVANDULEÆ. Areole extrorsely oblique; stamens included; corolla-lobes equal or the anterior lobe with the lateral ones forming the anterior lip.
CC. Stamens ascending, or in the Stachys Tribe sometimes included. (Consult also CCC.)
D. Perfect stamens 2; anther-cells linear, separate, solitary or confluent..... 5. MONARDA TRIBE.
DD. Perfect stamens 4, rarely 2 in the Nepeta Tribe.
E. Calyx usually 15-nerved; posterior stamens longer than the anterior..... 6. NEPETA TRIBE.
EE. Calyx 5- or 10-nerved; posterior stamens shorter than anterior; posterior lip of corolla erect, usually concave or fornicate, anterior spreading, 3-cut..... 7. STACHYS TRIBE.
F. Subtribe 1. SCUTELLARIEÆ. Calyx bilabiate or at length 2-parted, the mouth closed after anthesis.
FF. Calyx not bilabiate.
G. Subtribe 2. MELITTEÆ. Corolla-tube long-exserted; calyx broad, of 5 short teeth or 3–4 broad lobes.
GG. Corolla-tube included or slightly exserted, rarely long-exserted; calyx tubular or bell-shaped, 5–10-toothed.
H. Subtribe 3. MARRUBIEÆ. Stamens included.
HH. Subtribe 4. LAMIEÆ. Stamens exserted.
CCC. Stamens straight, diverging or ascending; perfect ones 4 or 2; calyx 5-, 10-, or 13-nerved, rarely 15-nerved; corolla-lobes usually flat..... 8. SATUREIA TRIBE.
D. Subtribe 1. POGOSTEMONEÆ. Anthers 1-celled, subglobose; stamens distinct, straight.
DD. Anthers 2-celled, at least the younger ones.
E. Subtribe 2. MENTHOIDEÆ. Calyx usually 5- or 10-nerved; stamens distant or divaricate.
EE. Subtribe 3. MELISSEÆ. Calyx usually 13-nerved; stamens ascending, at least at the base.

II. Key to the Tribes.

1. Prasia Tribe.

Not in cultivation.

2. Prostanthera Tribe.

A. Calyx bilabiate; lips entire or anterior emarginate..... 1. *Prostanthera.*
AA. Calyx equal, 5-toothed..... 2. *Westringia.*

3. Ajuga Tribe.

A. Corolla-tube slender, lobes 5, subequal, spreading..... 3. *Trichostema.*
AA. Corolla-tube, quasi 1-lipped, the posterior lobes and small lateral ones declinate at the contracted base of the very large anterior lobe, or rarely erect..... 4. *Teucrium.*
AAA. Corolla-tube short or exserted, the posterior lip short, erect, 2-cut, anterior much longer and its middle lobe largest..... 5. *Ajuga.*

4. Ocimum Tribe.

A. Subtribe 1. EUOCIMEÆ.
B. Anterior lobe of corolla hardly longer than the others, often narrower, declinate, flat or slightly concave.
C. Fruiting calyx deflexed..... 6. *Ocimum.*
CC. Fruiting calyx scarcely enlarging, often declinate..... 7. *Moschosma.*
BB. Anterior lobe of corolla longer than others, concave or boat-shaped.
C. Filaments connate at the base in a tube... 8. *Coleus.*
CC. Filaments free..... 9. *Plectranthus.*
AA. Subtribe 2. LAVANDULEÆ. Sole genus.....10. *Lavandula.*

5. Monarda Tribe.

A. Calyx tubular.....11. *Monarda.*
AA. Calyx bilabiate.
B. Fertile anther-cells 2: upper lip of corolla 4-lobed.....12. *Perowskia.*
BB. Fertile anther-cells 1: upper lip of corolla entire or bifid.
C. Connective continuous with filament and not indicated unless by a slender reflexed tooth.....13. *Rosmarinus.*
CC. Connective articulated to the filament but not produced or very shortly acuminate.....14. *Audibertia.*
CCC. Connective elongated, versatile on the short filament, its sterile end continued beyond the articulation and either dilated or bearing an abortive rudiment of the second anther-cell.....15. *Salvia.*

6. Nepeta Tribe.

A. Calyx bilabiate or with the posterior tooth much wider than the others.....16. *Dracocephalum.*
AA. Calyx tubular, mouth straight or oblique.
B. Stamens erect or divergent; anther-cells parallel or at length divergent.....17. *Lophanthus.*
BB. Stamens ascending or straightish; anther-cells parallel.....18. *Cedronella.*
BBB. Stamens ascending and parallel or in a few species rather lax and distant; anther-cells divergent or divaricate.....19. *Nepeta.*

7. Stachys Tribe.

Subtribe 1. Scutellarieæ.

A. The calyx-lip entire.....20. *Scutellaria.*
AA. The posterior calyx-lip 3-toothed, anterior 2-fid.....21. *Brunella.*

Subtribe 2. Melitteæ.

A. Anther-cells parallel; calyx subequally 5-toothed.....22. *Physostegia.*
AA. Anther-cells divergent; calyx 3-lobed.....23. *Melittis.*

Subtribe 3. Marrubieæ.

Calyx 5–10-toothed; corolla-tube included; anther-cells at length confluent.....24. *Marrubium.*

Subtribe 4. Lamieæ.

A. The posterior lip of corolla often short or flat, glabrous or pubescent....25. *Colquhounia.*
AA. The posterior lip concave or fornicate, rarely flattish, usually villous.
B. Teeth of calyx 6–13, rarely 5.
C. Calyx very broad at apex....26. *Moluccella.*
CC. Calyx long-tubular....27. *Leonotis.*
BB. Teeth of calyx 5.
C. Stamens often cast to one side after anthesis....28. *Stachys.*
CC. Stamens often hairy on the back of the anthers....29. *Lamium.*
CCC. Stamens often have the posterior filaments appendaged at the base....30. *Phlomis.*

8. Satureia Tribe.

Subtribe 1. Pogostemoneæ.

Calyx, 5-toothed; corolla 4-cut; anterior lobes usually wider spreading....31. *Pogostemon.*

Subtribe 2. Menthoideæ.

A. Whorls spicate or racemose, not axillary.
B. Calyx equal, erect, often elongated in fr.; whorls many-fid....32. *Elsholtzia.*
BB. Calyx subequal in anthesis, but declinate and bilabiate in fr.; whorls 2-fid.
C. Nutlets smooth....33. *Collinsonia.*
CC. Nutlets netted-veined....34. *Perilla.*
AA. Whorls axillary (or, in a few species of Mentha, crowded in a dense terminal spike).
B. Perfect stamens 4....35. *Mentha.*
BB. Perfect stamens 2....36. *Cunila.*
AAA. Whorls in dense heads surrounded by involucral bracts.
B. Corolla sub-bilabiate; whorls densely many-fid.
C. Lobes of corolla ovate; heads often corymbose-panicled....37. *Pycnanthemum.*
CC. Lobes of corolla oblong or linear; heads globose, solitary....38. *Monardella.*
BB. Corolla bilabiate; whorls 2-fid., rarely more; heads solitary, crowded or corymbose panicled....39. *Origanum.*
AAAA. Whorls few-fid., axillary or the upper ones spicate; calyx-throat closed by villous hairs.40. *Thymus.*
AAAAA. Whorls axillary or the highest spicate; calyx open-bell-shaped, equal.
B. Calyx 10-nerved; stamens ascending....41. *Satureia.*
BB. Calyx 15-nerved; stamens divergent....42. *Hyssopus.*

Subtribe 3. Melisseæ.

A. Posterior lip of corolla concave, sickle-shape or galeate....43. *Acantho-*
AA. Posterior lip of corolla flattish or slightly concave. *[mintha.*
B. Calyx distinctly 2-lipped.
C. Corolla-tube straight or slightly curved...44. *Satureia* §
CC. Corolla-tube below the middle recurved-ascending....45. *Melissa.* *[Calamintha.*
BB. Calyx equal or sub-bilabiate.
C. Perfect stamens 4....46. *Micromeria.*
CC. Perfect stamens 2....47. *Hedeoma.*

Other genera treated are: Eremostachys, Galeopsis, Pycnostachys, Sideritis, Synandra and Tinnea.

144. PLANTAGINACEÆ.

One genus in cultivation.... .... *Plantago.*

145. NYCTAGINACEÆ.

A. Fls. involucrate.
B. Stigma with a small head; anthers didynamous.... 1. *Mirabilis.*
BB. Stigma linear; anthers not didynamous.... 2. *Abronia.*
AA. Fls. not involucrate, but bracted.
B. Bracts large, colored.... 3. *Bougain-* *[villea.*
BB. Bracts very small.... 4. *Pisonia.*

146. AMARANTACEÆ.

A Anthers 2-celled.
B. Ovary 2-ovuled.
C. Fr. a utricle.... 1. *Celosia.*
CC. Fr. berry-like.... 2. *Deeringia.*
BB. Ovary 1-ovuled.
C. Ovule erect, with a short funiculus.
D. Segms. of perianth stellate in fr.: fls. in terminal racemes: shrubs.... 3. *Bosea.*
DD. Segms. of perianth upright in fr.: fls. in clusters or panicles: herbs.... 4. *Amarantus.*
CC. Ovule suspended from the apex of an elongated funiculus.
D. Perianth-segms. scarious at apex, connate at base.... 5. *Trichinium.*
DD. Perianth-segms. hyaline, membranous or somewhat papery, lanate.... 6. *Ærva.*
AA. Anthers 1-celled.
B. Fls. minute in glomerules or little-spiked along the sparse branches of the panicle.. 7. *Iresine.*
BB. Fls. in heads or spikes rarely panicled.
C. Stigmas 2.
D. Perianth-segms. free or connate at base. 8. *Gomphrena*
DD. Perianth-tube 5-cut, cristate or winged in fr.... 9. *Frælichia.*
CC. Stigma simple.
D. Staminal tube short or long, with 5 anther-bearing awl-shaped laciniæ and 5 antherless laciniæ interposed....10. *Telanthera.*
DD. Staminal tubes with no antherless laciniæ interposed....11. *Pfaffia.*

147. CHENOPODIACEÆ.

A. Fls. with 4 bractlets, 2 of which are adnate to the perianth at the base, or higher.
B. Embryo spiral: filaments straight in the bud. 1. *Basella.*
BB. Embryo semi-annular: filaments recurved at apex or lower in the bud.... 2. *Boussin-*
AA. Fls. with bractlets not adnate to perianth. *[gaultia.*
B. Embryo spiral: endosperm scant or 0.... 3. *Salsola.*
BB. Embryo ring-shaped or horseshoe-shaped: endosperm copious. (Salicornia has conduplicate embryo and no endosperm.)
C. St. and branches articulated: fls. immersed in caves in the superposed joints: no foliage-lvs.... 4. *Salicornia.*
CC. St. not articulated.
D. Perianths heteromorphous; staminate without bracts, 3–5-lobed or parted; pistillate usually 0: fls. with 2 bractlets accrescent in fr. free or connate into a sack, and no perianth.
E. Pistillate fls. without perianth, 3–4-toothed.... 5. *Spinacia.*
EE. Pistillate fls. with ample bracts which enlarge in fr.; perianth 0.... 6. *Atriplex.*
DD. Perianths homomorphous, i.e., not of two different forms in the same plant.
E. Fls. hermaphrodite and feminine, solitary or glomerate: seed horizontal; embryo annular; albumen scant.... 7. *Kochia.*
EE. Fls. glomerate, hermaphrodite or unisexual: seed erect, inverse or horizontal; embryo annual or horseshoe-shaped.
F. Perianth-tube surrounded by a wing; stamens 5: seed horizontal, bony.... 8. *Cycloloma.*
FF. Perianth 5-parted, usually unchanged in fr.: stamens 1–5: seed erect or horizontal, bony or leathery.... 9. *Chenopod-* *[ium.*
FFF. Perianth 5-lobed, hardened at the base in fr.: seed horizontal, leathery....10. *Beta.*

The genus Ullucus, allied to Basella, is also described briefly.

148. PHYTOLACCACEÆ.

A. Ovary superior.
B. Carpel 1.... 1. *Rivina.*
BB. Carpels 2-∞, united into a berry.... 2. *Phytolacca.*
BBB. Carpels 1 or 2, united, the fr. with scales at top.... 3. *Petiveria.*
AA. Ovary semi-inferior: fr. inferior.... 4. *Agdestis.*

149. POLYGONACEÆ.

A. The fls. fascicled in the axils or at the nodes of infl. (In the first 3 genera sometimes along the rachis of infl.)
B. Endosperm 3–6-lobed with longitudinal grooves and usually ruminate.
C. Fruiting perianth fleshy or berry-like at the base or everywhere, the nut included or exserted at the apex.... 1. *Muehlen-* *[beckia.*
CC. Fruiting perianth with fleshy or berry-like tube, including the nut and often adnate to it, crowned by the unchanged connivent or marcescent limb.... 2. *Coccoloba.*

CCC. Fruiting perianth enlarged, membranous or scarious, colored, outer segms. larger and broadly cordate, inner ones oblong ... 3. *Antigonon.*
CCCC. Fruiting perianth developing wings on the 3 outer parts ... 4. *Triplaris.*
EE. Endosperm equable, entire.
C. Perianth 5-merous, rarely 4-merous; styles usually filiform and stigmas usually capitate.
D. Pistil 2–3-merous; stamens usually 6–8: shrubs, often spinescent ... 5. *Atraphaxis.*
DD. Pistil 3-merous: stamens 8 or fewer: herbaceous, rarely suffruticose.
E. Nut entirely or nearly covered by the fruiting perianth ... 6. *Polygonum.*
EE. Nut much longer than the fruiting perianth ... 7. *Fagopyrum.*
CC. Perianth 6-merous, rarely 4-merous.
D. Stamens 9, rarely 6; fruiting perianth unchanged: nut 3-winged ... 8. *Rheum.*
DD. Stamens 6, rarely 9; inner segms. of fruiting perianth much enlarged, erect and including the 3-angled nut ... 9. *Rumex.*
AA. The fls. in infl. dichotomously or umbellately branched, the floral lvs. or bracts connate below the branches into one 3-cut bract, or free and 3–∞ in number ... 10. *Eriogonum.*

150. NEPENTHACEÆ.

The only genus ... *Nepenthes.*

151. ARISTOLOCHIACEÆ.

A. Perianth persistent, 3-lobed above ovary; regular stamens 12 surrounding the style in 2 series; anthers free ... 1. *Asarum.*
AA. Perianth deciduous, irregular, polymorphous; anthers 6–∞, adnate in 1 series to a stylar column ... 2. *Aristolochia.*

152. SAURURACEÆ.

A. Stamens 3 ... 1. *Houttuynia.*
AA. Stamens 5–8.
B. Carpels connate ... 2. *Anemopsis.*
BB. Carpels distinct ... 3. *Saururus.*

153. PIPERACEÆ.

A. Stamens 2–6; anther-cells usually distinct; stigmas 3–4, rarely 2 or 5 ... 1. *Piper.*
AA. Stamens 2, anther-cells confluent into one 2-valved anther; stigma terminal or lateral, penicillate or undivided ... 2. *Peperomia.*

154. CHLORANTHACEÆ.

In cultivation ... *Chloranthus.*

155. MYRISTICACEÆ.

Sole genus ... *Myristica.*

156. MONIMIACEÆ.

A. Stamens numerous; anther-cells dehiscing in a 2-valved fashion by a longitudinal crack ... 1. *Peumus.*
AA. Stamens 6–12; anther-cells dehiscing above ... 2. *Laurelia.*

157. LAURACEÆ.

A. Anthers 2-locellate, valves laterally dehiscent or quickly deciduous ... 1. *Hernandia.*
AA. Anthers extrorsely locellate, valves dehiscent upwards.
B. The whole perianth persisting under the fr., appressed or slightly spreading; perianth sometimes deciduous from the base ... 2. *Persea.*
BB. The perianth-segms. at length transversely cut, leaving the fruiting tube bell-shaped or expanded and 6-toothed ... 3. *Cinnamomum.*
BBB. The perianth-segms. deciduous from base, fruiting tube flattened or disk-shaped and entire or truncate ... 4. *Cinnamomum* § *Camphora.*
AAA. Anthers introrsely locellate; valves dehiscing upward.
B. Fls. in a short, lax raceme, accompanied by small and narrow bracts ... 5. *Sassafras.*
BB. Fls. umbellate, capitate or rarely solitary; umbels or heads before anthesis included in a 4–6-bracted involucre.
C. Locellæ of anther 4 ... 6. *Umbellularia.*
CC. Locellæ 2.
D. Stamens usually 9; fls. dicœcious ... 7. *Benzoin.*
DD. Stamens usually 12–20; fls. polygamous ... 8. *Laurus.*

The genus Litsea is sparingly in cultivation.

158. THYMELÆACEÆ.

A. Stamens fewer than the corolla-lobes ... 1. *Pimelea.*
AA. Stamens twice as many as corolla-lobes.
B. Disk 0 or a very short ring.
C. Perianth-tube cylindrical; limb spreading ... 2. *Daphne.*
CC. Perianth much swollen above, obliquely truncate; limb not spreading ... 3. *Dirca.*
BB. Disk more or less lobed or oblique.
C. Fls. 5-merous; disk cup-shaped ... 4. *Dais.*
CC. Fls. 4-merous.
D. The disk annular; lobes very short ... 5. *Edgeworthia.*
DD. The disk 4-cut or 2-cut ... 6. *Wikstræmia.*

The genera Gnidia, Lagetta, and Thymelæa will also be found in the book.

159. PROTEACEÆ.

Series 1. Fr. an indehiscent nut or drupe: fls. usually solitary with a bract under each one.

A. Fls. dicœcious by abortion, regular ... 1. *Leucadendron.*
AA. Fls. hermaphrodite, irregular ... 2. *Protea.*

Series 2. Fr. follicular, capsular or rarely indehiscent and subdrupaceous: fls. usually in pairs along the rachis with only 1 bract for each pair.

A. Ovules 2, collateral.
B. Fls. racemose or fascicled; involucre none or inconspicuous; bracts deciduous.
C. The ovules pendulous, orthotropous.
D. Fr. scarcely or tardily dehiscent; pericarp thick, fleshy or hard; seeds with thick, often unequal cotyledons.
E. Perianth-limb recurved ... 3. *Guevina.*
EE. Perianth straight ... 4. *Macadamia.*
DD. Fr. follicular or obliquely 2-valved; seeds compressed, margined or wing ... 5. *Roupala.*
CC. The ovules laterally affixed or ascending.
D. Seeds with or without a narrow wing ... 6. *Grevillea.*
DD. Seeds samara-like; wing oblong, terminal ... 7. *Hakea.*
BB. Fls. in dense bracted spikes or cones ... 8. *Banksia.*
AA. Ovules 4 or more.
B. Fls. umbellate: seeds winged below ... 9. *Stenocarpus.*
BB. Fls. in dense racemes: seeds samara-like, with an oblong terminal wing ... 10. *Telopea.*
BBB. Fls. twin, in short or long racemes: seeds samara-like with a terminal truncate wing ... 11. *Lomatia.*

160. ELÆAGNACEÆ.

A. Lvs. alternate: stamens 4.
B. Fls. hermaphrodite ... 1. *Elæagnus.*
BB. Fls. unisexual, usually dicœcious ... 2. *Hippophaë.*
AA. Lvs. opposite: stamens 8 ... 3. *Shepherdia.*

161. LORANTHACEÆ.

A. Perianth double ... 1. *Loranthus.*
AA. Perianth single or simple ... 2. *Phoradendron.*

Viscum is also of general interest.

162. SANTALACEÆ.

A. Plant herbaceous, low ... 1. *Comandra.*
AA. Plant woody, shrubs or trees.
B. Fls. perfect ... 2. *Santalum.*
BB. Fls. dicœcious or polygamous.
C. Lvs. alternate ... 3. *Pyularia.*
CC. Lvs. opposite ... 4. *Buckleya.*

163. PLATANACEÆ.

Sole genus..... *Platanus.*

164. MORACEÆ.

A. Anthers reversed on the bud with inflexed filaments.
  B. The male fls. spicate, racemose or capitate; female globose, capitate.
    C. Female perianth dentate..... 1. *Broussonetia.*
    CC. Female perianth deeply 4-fid..... 2. *Maclura.*
  BB. The fls. of either sex spicate; spikes short and dense or long and lax..... 3. *Morus.*
BBB. The fls. crowded on fleshy receptacle..... 4. *Dorstenia.*
AA. Anthers erect from the beginning.
  B. Plants, trees or shrubs: fls. usually on a fleshy receptacle.
    C. The receptacle fleshy, globose or ovoid, clearly inclosing the numerous fls., but with a small mouth which is bracteate introrsely; the mouth is closed in fr..... 5. *Ficus.*
    CC. The receptacle androgynous, male fls. numerous, females solitary in the center of the receptacle..... 6. *Brosimum.*
    CCC. The receptacle unisexual, with an involucre of numerous bracts overlapping in series..... 7. *Antiaris.*
    CCCC. The fl.-clusters unisexual, with or without 3–4 bracts at the base, in heads, spikes, rarely in racemes or the female 1-fid.
      D. Stamens 4..... 8. *Cudrania.*
      DD. Stamens 1..... 9. *Artocarpus.*
  BB. Plants, herbs: fls. not on a fleshy receptacle.
    C. St. climbing: lvs. opposite: embryo spirally involute..... 10. *Humulus.*
    CC. St. not climbing: lvs. alternate or the lowest opposite: embryo curved..... 11. *Cannabis.*

Coussapoa is also briefly treated.

165. URTICACEÆ.

A. Hairs stinging.
  B. Achene straight..... 1. *Urtica.*
  BB. Achene oblique..... 2. *Urera.*
AA. Hairs harmless.
  B. Perianth of the female fl., 3–5-parted.
    C. Lvs. opposite: stamens 4, rarely 2–3..... 3. *Pilea.*
    CC. Lvs. alternate, distichous, oblique at base: stamens 5, rarely 4..... 4. *Pellionia.*
  BB. Perianth of the female fl. tubular, inclosing the achene, not adnate: lvs. opposite or alternate: fls. in clusters or panicles..... 5. *Boehmeria.*
BBB. Perianth of the female fl. tubular adnate to the achene: lvs. alternate, tomentose below: fls. in globular heads often forming cymes..... 6. *Debregeasia.*

Helxine, Parietaria, and Pipturus are described.

166. ULMACEÆ.

A. Fr. drupaceous: fls. on the young growth.
  B. Cotyledons very broad.
    C. Sepals connate; style excentric..... 1. *Zelkova.*
    CC. Sepals distinct or nearly so; style central.
      D. Fr. globose, not winged..... 2. *Celtis.*
      DD. Fr. winged..... 3. *Pterocelti.*
  BB. Cotyledons narrow.
    C. Fertile fls. perfect; fls. in cymes..... 4. *Trema.*
    CC. Fertile fls. unisexual, solitary, staminate in cymes before the lvs..... 5. *Aphananthe.*
AA. Fr. not drupaceous, winged or muricate: fls. on last year's branches.
  B. Fr. stalked, surrounded by a broad wing.... 6. *Ulmus.*
  BB. Fr. not winged, everywhere somewhat fleshy and muricate..... 7. *Planera.*

167. JUGLANDACEÆ.

A. The fls. of either sex in erect spikes, imbricate-bractate..... 1. *Platycarya.*
AA. The staminate fls. in pendulous catkins; pistillate fls. spicate or subsolitary.
  B. In germinating, cotyledons are borne above ground and remain green..... 2. *Pterocarya.*
  BB. In germinating, cotyledons remain inside the nut.
    C. Husk at length splitting into segms.; nut smooth or angled..... 3. *Carya.*
    CC. Husk indehiscent; nut wrinkled or sculptured..... 4. *Juglans.*

168. LEITNERIACEÆ.

The only genus..... *Leitneria.*

169. MYRICACEÆ.

A. Lvs. serrate or entire, not stipulate: ovary subtended by 2–4 bractlets..... 1. *Myrica.*
AA. Lvs. pinnatifid, stipulate: ovary subtended by 8 linear, persistent bractlets..... 2. *Comptonia.*

170. CASUARINACEÆ.

Sole genus..... *Casuarina.*

171. EUPHORBIACEÆ.

A. Ovules 2 in each cell of ovary: plant without milky juice (or red juice in Bischofia).
  B. Lvs. alternate, simple (sometimes opposite in Poranthera).
    C. Calyx of staminate fls. imbricate.
      D. Petals present, at least in staminate fls.
        E. Plant a shrub with broad, glabrous or somewhat hairy lvs.: ovary 3-celled..... 1. *Andrachne.*
        EE. Plant a tree, with scaly herbage: ovary 1-celled..... 2. *Æxtoxicon.*
        EEE. Plant a heath-like sub-shrub: lvs. narrow, with recurved margin..... 3. *Poranthera.*
      DD. Petals 0.
        E. Fls. single or in axillary clusters.
          F. Styles slender or only broadened at apex.
            G. Rudimentary pistil present in staminate fls.; disk present: lvs. entire.
              H. Seed grooved on inner face: disk of pistillate fl. lobed... 4. *Flueggea.*
              HH. Seed not grooved: disk entire..... 5. *Securinega.*
            GG. Rudimentary pistil absent.
              H. Disk present..... 6. *Phyllanthus.*
              HH. Disk absent, at least from pistillate fls.
                I. Fr. a caps..... 7. *Glochidion.*
                II. Fr. more or less fleshy.
                  J. The styles 2-parted..... 8. *Breynia.*
                  JJ. The styles almost entire.. 9. *Sauropus.*
          FF. Styles broad, spreading.
            G. Stamens arising from a disk.
              H. Staminate fls. with rudimentary pistil..... 10. *Drypetes.*
              HH. Staminate fls. without rudimentary pistil..... 11. *Hemicyclia.*
            GG. Stamens 2–4, without disk..... 12. *Putranjiva.*
        EE. Fls. in elongated catkin-like or branched infl., dicœcious: lvs. large, broad and plane.
          F. Ovary 1-celled; stamens 2–5..... 13. *Antidesma.*
          FF. Ovary 2–5-celled.
            G. Staminate fls. with rudimentary pistil..... 14. *Baccaurea.*
            GG. Staminate fls. without rudimentary pistil..... 15. *Daphniphyllum.*
      CC. Calyx of staminate fls. valvate; petals small..... 16. *Lebidieropsis.*
  BB. Lvs. alternate, compound..... 17. *Bischofia.*
BBB. Lvs. opposite, compound..... 18. *Oldfieldia.*
BBBB. Lvs. whorled, simple..... 19. *Hyænanche.*
AA. Ovules 1 in each cell of the ovary.
  B. Fls. produced singly or in ordinary infl.
    C. Stamens incurved in the bud; pubescence stellate or scaly; juice not milky..... 20. *Croton.*
    CC. Stamens erect in the bud.
      D. Juice not milky (see also Codiæum and relatives): calyx valvate: lvs. simple.
        E. Staminate fls. with petals: herbs..... 21. *Chrozophora.*
        EE. Staminate fls. apetalous.
          F. Stamens much branched: herbs with lvs. palmately veined and peltate..... 22. *Ricinus.*
          FF. Stamens not branched.
            G. Lvs. opposite: styles free (see also Mallotus).
              H. The stamens as many as 50.. 23. *Trewia.*
              HH. The stamens 8–20..... 24. *Mercurialis.*
            GG. Lvs. alternate, or rarely opposite.
              H. Plant a thorny shrub: stamens 8–15..... 25. *Adelia.*
              HH. Plant with holly-like spiny margined lvs.: stamens 3–8. 26. *Alchornea.*

HHH. Plant unarmed or with stinging hairs.
I. Styles free or united only at base.
J. Anther-cella spherical to oblong.
K. Anthers 2-celled.....27. *Mallotus.*
KK. Anthers 3–4-celled: lvs. usually peltate.....28. *Macaranga.*
JJ. Anther-cells elongated, often vermiform.....29. *Acalypha.*
II. Styles united above the base: st. often climbing.
J. Infl. without conspicuous involucre.
K. Number of stamens usually 3; styles free at apex.....30. *Tragia.*
KK. Number of stamens 8–30; styles united to the apex into a swollen column.....31. *Plukenetia.*
JJ. Infl. subtended by a conspicuous involucre.....32. *Dalechampia.*
DD. Juice almost always more or less milky (chief exceptions in Cluytia and relatives).
E. The fls. with petals, at least the staminate.
F. Calyx valvate.
G. Lvs. simple, palmate.....33. *Aleurites.*
GG. Lvs. compound.....34. *Joannesia.*
FF. Calyx imbricate.
G. Petals free from one another.
H. The stamens in 2 or more whorls.
I. Number of stamens about 10: lvs. usually palmately veined.....35. *Jatropha.*
II. Number of stamens 15–30 or more: lvs. pinnately veined: styles entire.....36. *Codiæum.*
HH. The stamens in 1 whorl, usually about 3–5.....37. *Cluytia.*
GG. Petals connate: lvs. usually palmately veined.
H. Some of the filaments united: lvs. simple.....35. *Jatropha.*
HH. Filaments free: lvs. compound.38. *Ricinodendron.*
EE. The fls. apetalous.
F. Sepals valvate or slightly imbricate in some.
G. Lvs. trifoliate.....39. *Hevea.*
GG. Lvs. simple, pinnately veined.
H. Number of stamens 3: lvs. spiny margined.....40. *Pachystroma.*
HH. Number of stamens 1: lvs. not spiny.....41. *Ophthalmoblapton.*
FF. Sepals or lobes of calyx, if any, imbricate: lvs. simple.
G. Number of stamens usually 10 or more (5–50).
H. Staminate calyx with 5 sepals connate, at least at base: lvs. usually palmately veined: st. erect.
I. Herbage with stinging hairs.35. *Jatropha.*
II. Herbage usually glabrous..42. *Manihot.*
HH. Staminate calyx 3–5-lobed: lvs. pinnately veined: st. climbing or trailing.....43. *Mabea.*
HHH. Staminate calyx of 1 or 2 sepals.....44. *Homalanthus.*
HHHH. Staminate calyx cupulate, truncate or dentate: lvs. broad, hairy.....45. *Hura.*
GG. Number of stamens 1–5.
H. Staminate calyx with 4–5 free sepals: st. climbing.....46. *Omphalia.*
HH. Staminate calyx with 2–3 sepals, free or connate at base.
I. Infl. usually terminal: seed carunculate.....47. *Sebastiana.*
II. Infl. usually axillary: seed not carunculate.....48. *Excœcaria.*
HHH. Staminate calyx with connate sepals, 1–3-lobed.
I. The stamens 2–3.
J. Stamens free.
K. Base of caps. persistent as a pointed piece...49. *Sapium.*
KK. Base of caps. not persistent, only a 3-parted central column remaining...50. *Stillingia.*
JJ. Stamens united.
K. Pistil 4-celled.....51. *Maprounia.*
KK. Pistil 6–9-celled.....52. *Hippomane.*
II. The stamens 1
J. Infl. terminal.....51. *Maprounia.*
JJ. Infl. lateral or axillary...41. *Ophthalmoblapton.*
HHHH. Staminate calyx 0, or rarely 1–2 minute scales.....53. *Colliguaya.*
BB. Fls. in cyathia (see explanation under Euphorbia).
C. Cyathia regular or nearly so.
D. Involucral glands free from one another, alternate with lobes of involucre.....54. *Euphorbia.*
DD. Involucral glands united into a ring around the lobes.....55. *Synadenium.*
CC. Cyathia decidedly irregular.....56. *Pedilanthus.*

172. BUXACEÆ.

A. Cells of ovary with 2 ovules each; stamens 4.
B. Lvs. alternate.
C. Evergreen shrubs: lvs. entire..... 1. *Sarcococca.*
CC. Evergreen herbs: lvs. dentate..... 2. *Pachysandra.*
BB. Lvs. opposite..... 3. *Buxus.*
AA. Cells of ovary with 1 ovule each; stamens numerous: lvs. opposite..... 4. *Simmondsia.*

173. BETULACEÆ.

A. Staminate fls. with 4 perianth-segms. or by abortion fewer (Birch Tribe).
B. Stamens 2..... 1. *Betula.*
BB. Stamens 4..... 2. *Alnus.*
AA. Staminate fls. with no perianth (Hazel Tribe).
B. Nut large, inclosed by a leafy involucre: staminate fls. with 2 bractlets; pistillate fls. 2–4, capitate..... 3. *Corylus.*
BB. Nut small, subtended by or inclosed in a large bractlet: staminate fls. with no bractlets; pistillate catkins spike-like.
C. Fruiting bractlet flat, 3-cleft and incised.. 4. *Carpinus.*
CC. Fruiting bractlet bladder-like, closed, membranous..... 5. *Ostrya.*

174. FAGACEÆ.

A. Ovary of pistillate fls. 6-celled; spikes of either sex erect and strict: fruiting involucre or bur densely covered with strong pickles..... 1. *Castanea.*
AA. Ovary of pistillate fls. 3-celled, rarely 4- or 5-celled in some species of Quercus.
B. Staminate fls. 1–3 in a cluster: lvs. usually small..... 2. *Nothofagus.*
BB. Staminate fls. in loose, roundish pendulous heads: lvs. generally large..... 3. *Fagus.*
BBB. Staminate fls. in pendulous catkins or the spikes of either sex erect and strict.
C. Involucre of numerous acales forming a cup in fr. and subtending the acorn.... 4. *Quercus.*
CC. Involucre in fr. armed with clusters of prickles or tubercles, wholly including the fr., perfectly closed or at length split irregularly..... 5. *Castanopsis.*

175. SALICACEÆ.

A. Lvs. usually narrow: disk composed of 1 or 2 glands which are distinct or barely connate at base..... 1. *Salix.*
AA. Lvs. usually broad: disk cyathiform, often oblique or cup-shaped, entire or lobed.... 2. *Populus.*

176. EMPETRACEÆ.

A. Fls. axillary, solitary; stamens 3; pistil 6–9-merous..... 1. *Empetrum.*
AA. Fls. axillary in 2's or 3's; stamens 2; pistil 2-merous..... 2. *Ceratiola.*
AAA. Fls. subcapitate; stamens usually 3; pistil 3-merous..... 3. *Corema.*

177. GINKGOACEÆ.

Ovule-bearing blade, long-stalked, shortly 2–∞ cut at apex, the lobes dilated into a ring or short cup adnate to the seed: anther-cells 2, pendulous: lvs. fan-shaped..... *Ginkgo.*

178. GNETACEÆ.

Leafless shrubs with jointed branches and scales opposite the nodes connate into a little sheath.. *Ephedra.*

The very curious genus Welwitschia may be found in botanical collections.

179. TAXACEÆ.

A. Anthers 2-celled: tropical or subtropical trees and shrubs.
  B. Scales of pistillate aments few, adnate to peduncle and with it usually fleshy: lvs. linear to ovate, rarely scale-like..... 1. *Podocarpus.*
  BB. Scales of pistillate aments short, broad and somewhat fleshy, imbricate: lvs. minute and scale-like: branchlets flattened and lf.-like..... 2. *Phyllocladus.*
AA. Anthers 3–8-celled: lvs. linear: hardy or nearly hardy trees and shrubs.
  B. Pistillate fls. consisting of several decussate 2-ovuled carpicles: lvs. with 2 glaucous lines below broader than the 3 green lines..... 3. *Cephalotaxus.*
  BB. Pistillate fls. reduced to 1 ovule.
    C. Carpicles at maturity inclosing the seed and adnate to it: anthers 4-celled, cells free: lvs. with 2 glaucous lines below narrower than the green lines..... 4. *Torreya.*
    CC. Carpicles at maturity partly inclosing the seed, not adnate to it: anthers 6–8-celled, cells connate: lvs. pale green below..... 5. *Taxus.*

180. PINACEÆ.

A. Lvs. spirally arranged.
  B. Carpicles simple; ovule 1, reversed; cone-scales with 1 seed.....1. ARAUCARIA TRIBE.
  BB. Carpicles divided into scale and bract, sometimes connate.
    C. Ovules 2, reversed; scale and bract always distinct; cone-scales with 2 usually winged seeds.....2. ABIES TRIBE.
    CC. Ovules 2–8, axillary and upright or on the scale and at least finally reversed; cone-scales with 2–8 seeds.....3. TAXODIUM TRIBE.
AA. Lvs. opposite or whorled, often scale-like: ovules upright.....4. CUPRESSUS TRIBE.

1. Araucaria Tribe.

A. Seeds free from the scale, with 1 or 2 wings: lvs. broad, generally elliptic, more or less distichous and rather remote..... 1. *Agathis.*
AA. Seeds adnate to the winged or wingless scale: lvs. large, scale-like or needle-shaped, spirally arranged, crowded..... 2. *Araucaria.*

2. Abies Tribe.

A. Foliage deciduous, partly fascicled.
  B. Male fls. solitary in a leafless scaly bud; connective not produced beyond anther-cells nor scarcely prominent: cones reflexed; scales persistent..... 3. *Larix.*
  BB. Male fls. clustered, pendulous: cone-scales deciduous..... 4. *Pseudolarix.*
AA. Foliage evergreen.
  B. Connective of anthers usually produced into a scale-like appendage.
    C. Male fls. subspicate at base of new shoots: cone-scales persistent: lvs. in clusters of 2–5, rarely solitary..... 5. *Pinus.*
    CC. Male fls. solitary in the cluster of lvs. which terminate short branchlets: cone-scales finally deciduous: lvs. partly fascicled as in the larch..... 6. *Cedrus.*
    CCC. Male fls. solitary in the axils: cones reflexed; scales persistent: lvs. solitary, 4-angled or flattened and glaucous above, green on the back..... 7. *Picea.*
  BB. Connective of anthers simply umbonate beyond the cells or hardly prominent; male fls. solitary in axils: lvs. solitary, usually flattened, glaucous or paler below.
    C. Cones reflexed; scales persistent.
      D. Subtending bract conspicuous..... 8. *Pseudotsuga.*
      DD. Subtending bract small..... 9. *Tsuga.*
    CC. Cones erect.
      D. Scales peristent; seeds about as long as scales; bracts much shorter than scales: lvs. flattened, keeled above, pale below.....10. *Keteleeria.*
      DD. Scales deciduous; seeds shorter than scales; bracts shorter or longer: lvs. flattened and grooved above, usually glaucous below, rarely 4-angled.....11. *Abies.*

3. Taxodium Tribe.

A. Lvs. connate into pairs, arranged in whorls: ovule-bearing blade finally much increased and hardened, making the greater part of the woody cone.....12. *Sciadopitys.*
AA. Lvs. solitary, scattered.
  B. Scales of cone flat.
    C. Carpicles entire at apex: anther-cells 2–4: seeds surrounded by a narrow wing: lvs. lanceolate flat, rather large, glaucous below.....13. *Cunninghamia.*
    CC. Carpicles toothed at the apex: anther-cells 4–5: seeds 2–3-angled: lvs. awl-shaped, curved.....14. *Cryptomeria.*
  BB. Scales peltate.
    C. Seeds usually 5, narrowly winged: lvs. scale-like or linear, persistent.....15. *Sequoia.*
    CC. Seeds 2, angular: lvs. linear, deciduous with the branchlets.....16. *Taxodium.*

4. Cupressus Tribe.

A. Fr. a cone.
  B. Cone-scales all fertile, 4–8, forming apparently 1 whorl: lvs. usually scale-like, opposite or in whorls of 3 or 4, rarely alternate on aterile branches.....17. *Callitris.*
  BB. Cone-scales fertile at middle of cone and sterile at top and base.....18. *Fitzroya.*
  BBB. Cone-scales partly fertile, partly empty, arranged in opposite pairs: lvs. scale-like, opposite only on juvenile branches, sometimes needle-shaped.
    C. Scales of cone imbricate.
      D. Seeds 4–5; pairs of scales 3–4 (excluding the upper connate pair).....19. *Thujopsis.*
      DD. Seeds 2.
        E. Pairs of scales 4, the upper pair fertile.20. *Libocedrus.*
        EE. Pairs of scales 6–8; the 2 upper pairs fertile.....21. *Thuja.*
    CC. Scales of cone peltate.
      D. Number of seeds 2; cones small.
        E. Wings of seeds very large, unequal.22. *Fokienia.*
        EE. Wings of seeds narrow, equal.....23. *Chamæcyparis.*
      DD. Number of seeds many; cones usually rather large and woody.....24. *Cupressus.*
AA. Fr. fleshy, indehiscent berry or drupe, with 2–6 fertile scales: lvs. scale-like, opposite or needle-shaped and usually in 3's.....25. *Juniperus.*

Consult also the genus Athrotaxis, allied to Celphalotaxus and Sequoia.

181. CYCADACEÆ.

A. Lf.-segms. circinately involute in vernation: female cones proliferous after anthesis; scales elongate, the margins bearing 2 to many ovules..... 1. *Cycas.*
AA. Lf.-segms. straight in vernation: female cones deciduous after anthesis; scales peltate.
  B. Cone-scales superposed in vertical series.
    C. Shield of the scales transversely 2-horned at apex..... 2. *Ceratozamia.*
    CC. Shield of the scales truncate, not horned at apex..... 3. *Zamia.*
  BB. Cone-scales overlapping in alternating series.
    C. The lf.-segms. ribbed and nerved; nerves spreading on either side of midrib, very numerous, simple or forked..... 4. *Stangeria.*
    CC. The lf.-segms. with parallel, longitudinal nerves.
      D. Shield of cone-scales flat, erect, ovate-cordate..... 5. *Dioon.*
      DD. Shield thickened, ascending, usually prolonged into an erect, acuminate blade..... 6. *Macrozamia.*
      DDD. Shield thickened truncate, decurved at apex..... 7. *Encephalartos.*

The genera Bowenia and Microcycas are also included.

182. HYDROCHARITACEÆ.

A. St. elongated, submerged, everywhere leafy: lvs. short: spathes small, sessile in axils: placentæ little prominent in ovary..... 1. *Elodea.*
AA. St. very short, sometimes emitting creeping or floating stolons: lvs. crowded, immersed, sessile, elongated: spathes pedunculate: placentæ hardly prominent..... 2. *Vallisneria.*

AAA. St. very short: lvs. crowded, some sessile and submerged, others (except in Stratiotes) long-stalked, with a floating blade: spathes peduncled: placentæ of 2 lamellæ, strongly intruded, dividing the ovary more or less perfectly into 6 cells.
B. Styles 3; stamens 3–9..... 3. *Limnobium.*
BB. Styles 6, 2-fid.
C. Stamens with 6 2-fid filaments, of which 3 have 2 anthers and 3 have 1 anther.... 4. *Hydrocharis.*
CC. Stamens 11–15..... 5. *Stratiotes.*

183. ORCHIDACEÆ.*

I. Summary of Tribes.

A. Fertile stamens 2, with a broad shield-shaped sterile one (staminodium) .. 1. CYPRIPEDIUM
AA. Fertile stamen 1, with no staminodium. [TRIBE.
B. Anther persistent; pollinia with basal appendages.
C. The anther erect.
D. Stigma flat, unappendaged..... 2. SERAPIAS TRIBE.
DD. Stigma with appendages..... 3. HABENARIA TRIBE.
CC. The anthers placed obliquely..... 4. SATYRIUM TRIBE.
BB. Anther usually readily deciduous; pollinia not appendaged or with terminal ones.
C. Infl. terminal.
D. Lf.-buds convolute.
E. Lf.-blade not jointed to stalk.
F. The anther commonly much exceeding the beak of the column which is not distinctly cut.
G. Lip without hypochil, usually spurless.
H. St. short, with only 1 or 2 lvs..... 5. POGONIA TRIBE.
HH. St. long, with many lvs..... 6. VANILLA TRIBE.
GG. Lip with distinct hypochil, which is often spurred..... 7. CEPHALANTHERA
FF. The anther commonly about as long as the beak of the column which usually bears a sharp cut or groove. [TRIBE.
G. Pollinia waxy or powdery, not divided.
H. Lip turned down..... 8. SPIRANTHES TRIBE.
HH. Lip turned up ..... 9. CRANICHIS TRIBE.
GG. Pollinia divided into distinct masses..... 10. PHYSURUS TRIBE.
EE. Lf.-blade distinctly jointed to the petiole.
F. Pollinia 8: st. slender: fls. usually with spurs or chins..... 11. THUNIA TRIBE.
FF. Pollinia 4: st. a short pseudobulb: fls. without spurs or chins..... 12. CŒLOGYNE TRIBE.
DD. Lf.-buds conduplicate.
E. Sepals and petals about equally developed, the lip usually very conspicuous.
F. Lvs. usually not jointed: column footless..... 13. LIPARIS TRIBE.
FF. Lvs. usually jointed.
G. Nerves of lvs. 1.
H. Pollinia 2–4, with very short stalks..... 14. POLYSTACHYA
HH. Pollinia 4–8, with distinct caudicles. [TRIBE.
I. Column-foot forming a chin with the lateral sepals or a short sac with the lip..... 15. PONERA TRIBE.
II. Column footless..... 16. CATTLEYA TRIBE.
GG. Nerves of lvs. several.... 17. SOBRALIA TRIBE.
EE. Sepals much more developed than the petals and lip..... 18. PLEUROTHALLIS
CC. Infl. lateral, or on separate shoot. [TRIBE.
D. Lf.-buds convolute.
E. St. slender or gradually swollen.
F. Pollinia with caudicles but without stalks..... 19. PHAJUS TRIBE.
FF. Pollinia without caudicles but with stalks.
G. Lip jointed to column-foot or forming a spur with it..... 20. CYRTOPODIUM [TRIBE.
GG. Lip not jointed, often with a distinct hypochil. 21. CATASETUM TRIBE.
EE. St. a short distinct pseudobulb.
F. Lip jointed to the column-foot.
G. Callus-ridges lengthwise.. 22. LYCASTE TRIBE.
GG. Callus-ridges transverse . 23. ZYGOPETALUM
FF. Lip continuous with column-foot..... 24. GONGORA TRIBE. [TRIBE.
DD. Lf.-buds conduplicate.
E. St. terminating its growth in 1 year.
F. Lip movably jointed to foot of column.
G. Lvs. not strap-shaped: pollinia unappendaged or with either caudicles or stipes, but not with both.
H. Flowering st. arising from near the apex of the slender st. or from the pseudobulb. 25. DENDROBIUM
HH. Flowering st. arising under the pseudobulb or at the base of the st. [TRIBE.
I. Pollinia without appendages..... 26. BULBOPHYLLUM
II. Pollinia with distinct stalks. [TRIBE.
J. Pseudobulbs usually present: flowering st. arising lower than new growth..... 27. MAXILLARIA
JJ. Pseudobulbs usually wanting: flowering st. arising higher than new growth..... 28. HUNTLEYA TRIBE. [TRIBE.
GG. Lvs. strap-shaped: pollinia with broad caudicles and stipes..... 29. CYMBIDIUM TRIBE.
FF. Lip immovably united to foot of column.
G. Fls. with spurs..... 30. IONOPSIS TRIBE.
GG. Fls. without spurs.
H. The fls. narrow, not open..... 31. ADA TRIBE.
HH. The fls. wide, open.
I. Lip enrolled around the column..... 32. TRICHOPILIA
II. Lip not enrolled. [TRIBE.
J. The lip united to column to the middle..... 33. ASPASIA TRIBE.
JJ. The lip united only to the base of the column... 34. ODONTOGLOSSUM [TRIBE.
EE. St. increasing in length from year to year..... 35. AERIDES TRIBE.

*For explanation of orchid flowers and of terms, see the article *Orchids.*

II. Key to the Tribes.

1. Cypripedium Tribe.

A. Fl. persistent, withering on the ovary: lf.-buds convolute..... 1. *Cypriped-*
AA. Fl. soon deciduous: lf.-buds conduplicate. *[ium.*
B. Ovary 3-celled, the placentæ central; mouth of lip with broad inturned margin.. 2. *Phragmoped-*
BB. Ovary 1-celled, the placentæ parietal; mouth of lip usually with no broad inturned margins..... 3. *Paphio-* *[ilum.*
[pedilum.

2. Serapias Tribe.

A. Lip spurred.
B. Sepals free..... 4. *Orchis.*
BB. Sepals united into an arching hood..... 5. *Galeorchis.*
AA. Lip spurless.
B. Pollinia glands in a single sac..... 6. *Serapias.*
BB. Pollinia glands separate, in 2 distinct sacs... 7. *Ophrys.*

3. Habenaria Tribe.

A. Lip adnate to column at base; stigma broad... 8. *Cynorchis.*
AA. Lip free; stigma slender..... 9. *Habenaria.*

4. Satyrium Tribe

Dorsal sepal helmet-shaped.....10. *Disa.*

5. Pogonia Tribe.

A. Fls. on a scape with a terminal whorl of lf.-like bracts.....11. *Isotria.*
AA. Fls. on a leafy st.
B. Lip crested.....12. *Pogonia.*
BB. Lip not crested.....13. *Triphora.*

6. Vanilla Tribe.

Sts. rooting at nodes.....14. *Vanilla.*

7. Cephalanthera Tribe.

A. Fls. with a chin; lip long.....15. *Cephalanthera.*
AA. Fls. chinless; lip round.....16. *Epipactis.*

8. Spiranthes Tribe.

A. Dorsal sepal forming a hood with the petals.
B. Infl. 1-sided; fls. without a chin.....17. *Spiranthes.*
BB. Infl. not 1-sided; fls. with a chin.....18. *Stenorrhynchus.*
AA. Sepals and petals spreading.....19. *Listera.*

9. Cranichis Tribe.

Lip and petals inserted upon the elongated column.....20. *Ponthieva.*

10. Physurus Tribe.

A. Lip with a distinct spur.
B. Lvs. green: lip concave above the spur.....21. *Physurus.*
BB. Lvs. usually variegated: lip with a long fimbriate claw.....22. *Anœctochilus.*
AA. Lip spurless or nearly so.
B. Column straight; fls. symmetric.
C. The lip not clawed.....23. *Goodyera.*
CC. The lip clawed.....24. *Dossinia.*
BB. Column twisted; fls. not symmetric.
C. The column with 2 upright appendages in front.....25. *Macodes.*
CC. The column without appendages.....26. *Hæmaria.*

11. Thunia Tribe.

A. Fls. without chin.
B. Sts. without basal pseudobulbs.....27. *Thunia.*
BB. Sts. with basal pseudobulbs.....28. *Bletilla.*
AA. Fls. with a distinct chin, formed of lateral sepals and column-foot.....29. *Trichosma.*

12. Cœlogyne Tribe.

A. Base of lip with sac-like hollow.
B. Column short, winged above; sepals flat.....30. *Pholidota.*
BB. Column slender; sepals sac-like, concave.....31. *Neogyne.*
AA. Base of lip flat.
B. Column slender, without horns.
C. Lvs. and pseudobulbs perennial.....32. *Cœlogyne.*
CC. Lvs. and pseudobulbs annual.....33. *Pleione.*
BB. Column short, with 2 horns.....34. *Platyclinis.*

13. Liparis Tribe.

A. Lvs. green: fls. without chin.
B. Lip shoe-shaped.....35. *Calypso.*
BB. Lip not shoe-shaped.
C. Column short; lip turned upward.....36. *Microstylis.*
CC. Column slender; lip turned downward.....37. *Liparis.*
AA. Lvs. wanting: fls. with chin.....38. *Corallorrhiza.*

14. Polystachya Tribe.

A. Lip spurred.
B. Plant tuberous: spur slender.....39. *Tipularia.*
BB. Plant not tuberous: spur funnel-shaped.....40. *Galeandra.*
AA. Lip not spurred.
B. The lip 3-lobed.
C. Column short; chin distinct.....41. *Polystachya.*
CC. Column slender, curved; chin indistinct..42. *Ansellia.*
BB. The lip entire.....43. *Neobenthamia.*

15. Ponera Tribe.

A. Lip normal.
B. St. sleuder, leafy; no pseudobulbs: pollinia 4.44. *Isochilus.*
BB. St. a pseudobulb: pollinia 8.....45. *Cœlia.*
AA. Lip forming a beaker-like cavity, with the column, or the former hollow at base.
B. Young shoots at the apex of the old.....46. *Hexisea.*
BB. Young shoots from base of old.
C. Fls. in dense spikes; pollinia 8.....47. *Arpophyllum.*
CC. Fls. in short clusters; pollinia 4.....48. *Hartwegia.*

16. Cattleya Tribe.

A. Anther not toothed, nor in an excavation.
B. Pollinia 4.
C. Lip adnate to the column, at least at its base.
D. Ovary produced into a hollow neck....49. *Broughtonia.*
DD. Ovary not so produced.....50. *Epidendrum.*
CC. Lip free.
D. The lip flat, with 2 elevations on upper side.....51. *Diacrium.*
DD. The lip enrolled about column, with no elevations.....52. *Cattleya.*
BB. Pollinia 5–7, some of them often abortive....53. *Lælio-cattleya.*
BBB. Pollinia 8.
C. Stigma pitted upon the front of the column; anther inclined.
D. Base of lip gradually merging into blade.
E. Lip distinctly surrounding the column; sepals and petals not wavy.....54. *Lælia.*
EE. Lip not as above; sepals and petals distinctly wavy.....55. *Schomburgkia.*
DD. Base of lip tightly encompassing column, suddenly broadened into the broad blade.....56. *Brassavola.*
CC. Stigma running up on 2 extensions of the column-apex; anther erect.....57. *Sophronitis.*
AA. Anther 2-toothed below, in an excavation in the column.....58. *Leptotes.*

17. Sobralia Tribe.

A. St. many-lvd., not bulbous at base: lip not bearded.....59. *Sobralia.*
AA. St. 1- or 2-lvd., bulbous at base: lip bearded...60. *Calopogon.*

18. Pleurothallis Tribe.

A. Lip turned upward; lateral sepals united into a boat-shaped hood.....61. *Scaphosepalum.*
AA. Lip turned down.
B. Sepals united.....62. *Masdevallia.*
BB. Sepals free, or the lateral only united.
C. Dorsal sepal and petals attenuated into a club-shaped apex.....63. *Restrepia.*
CC. Dorsal sepal and petals not as above....64. *Pleurothallis.*

19. Phajus Tribe.

A. Lvs. not articulated to petiole.
B. Lip free, encompassing the column.....65. *Phajus.*
BB. Lip adnate to column, the blade spreading..66. *Calanthe.*
AA. Lvs. articulated to petiole.
B. Sepals and petals spreading.
C. Lip with its base tightly inclosing the column, the blade spreading.....67. *Limatodes.*
CC. Lip not inclosing column.
D. Fls. with distinct chin.....68. *Chysis.*
DD. Fls. without chin.
E. Pollinia 8.
F. Middle lobe of lip not clawed.....69. *Bletia.*
FF. Middle lobe of lip clawed.....70. *Spathoglottis.*
EE. Pollinia 4.....71. *Aplectrum.*
BB. Sepals and petals erect.....72. *Acanthophippium.*

20. Cyrtopodium Tribe.

A. Fls. spurred or with sac-like base.
B. Sepals narrower and less colored than petals. 73. *Lissochilus.*
BB. Sepals and petals alike or nearly so.....74. *Eulophia.*
AA. Fls. not spurred nor saccate.
B. Lip only inserted on column-foot.....75. *Cyrtopodium.*
BB. Lip and lateral sepals inserted on column-foot.
C. Chin distinct, rectangular.....76. *Warrea.*
CC. Chin indistinct, round.....77. *Eulophiella.*

21. Catasetum Tribe.

A. Fls. perfect; column twisted.....78. *Mormodes.*
AA. Fls. of 2 or 3 forms; column not twisted.
B. Column stout, straight; fls. with antennæ...79. *Catasetum.*
BB. Column slender, curved; fls. without antennæ.....80. *Cycnoches.*

22. Lycaste Tribe.

A. Pollinia upon a single stalk.
B. Fls. globose.....81. *Anguloa.*
BB. Fls. with spreading sepals and petals.
C. Stalk of pollinia long and narrow; fls. 1 to few.
D. Infl. of a single erect fl.; lip turned down.....82. *Lycaste.*

DD. Infl. of 2 to few drooping fls.; lip turned upwards ..... 83. *Paphinia.*
CC. Stalk of pollinia short; fls. many ..... 84. *Bateman-*[*nia.*
AA. Pollinia upon 2 separate stalks ..... 85. *Bifrenaria.*

23. Zygopetalum Tribe.

A. Lip clawed distinctly ..... 86. *Colax.*
AA. Lip not distinctly clawed. [*lum.*
B. The lip with horseshoe-shaped callus ..... 87. *Zygopeta-*
BB. The lip with few longitudinal lamellæ ..... 88. *Eriopsis.*

24. Gongora Tribe.

A. Lip turned downwards.
B. Fls. with sepals and petals erect or incurved.
C. Hypochil separated from column by a strong stricture; no pleuridia ..... 89. *Lacæna.*
CC. Hypochil united with column by a broad base; pleuridia present.
D. Epichil movably attached to hypochil; pollinia with short stalk at most ..... 90. *Peristeria.*
DD. Epichil immovably attached to hypochil; pollinia with elongated stalk ..... 91. *Acineta.*
BB. Fls. with sepals and petals spreading or reflexed.
C. Lateral sepala much larger than the dorsal sepal and petals ..... 92. *Coryanthes.*
CC. Sepals and petals nearly alike.
D. Hypochil concave; epichil flat.
E. Pollinia 2 ..... 93. *Stanhopea.*
EE. Pollinia 4 ..... 94. *Aganisia.*
DD. Hypochil not concave ..... 95. *Houlletia.*
AA. Lip turned upwards ..... 96. *Gongora.*

25. Dendrobium Tribe.

A. Sts. many-jointed; rhizome short.
B. Lip without callus, or with lamellate or elevated lines ..... 97. *Dendro-*[*bium.*
BB. Lip with basal callus: joints of st. long-filamentose ..... 98. *Inobulbon.*
AA. Sts. 1- or rarely 2-jointed; rhizome long-creeping ..... 99. *Sarcopod-*[*ium.*

26. Bulbophyllum Tribe.

A. Lateral sepals with their outer margins adhering, except at the free base ..... 100. *Cirrhopeta-*[*lum.*
AA. Lateral aepals free ..... 101. *Bulbophyl-*[*lum.*

27. Maxillaria Tribe.

A. Lip without claw, movable: lvs. normal ..... 102. *Maxillaria.*
AA. Lip clawed, or adnate to column-base: lvs. whip-shaped ..... 103. *Scuticaria.*

28. Huntleya Tribe.

A. Pseudobulbs distinct ..... 104. *Promenæa.*
AA. Pseudobulbs wanting or rudimentary.
B. Lip entire ..... 105. *Chondror-*[*rhyncha.*
BB. Lip lobed.
C. Callus of lip fringed ..... 106. *Huntleya.*
CC. Callus not fringed.
D. Column boat-shaped, concave ..... 107. *Bollea.*
DD. Column slender, not concave.
E. Claw very short: callus free in front and resting upon the lip ..... 108. *Warscewic-*[*zella.*
EE. Claw distinct: callus not free in front. 109. *Pescatorea.*

29. Cymbidium Tribe.

A. Lvs. many: sts. elongated ..... 110. *Grammat-*[*ophyllum.*
AA. Lvs. few: sts. short.
B. Sts. concealed by the lf.-sheaths.
C. Pollinia pear-shaped, upon a quadrate stalk: st. not bulbous ..... 111. *Cyperor-*[*chis.*
CC. Pollinia round, upon a stalk much broader than high: st. bulbous ..... 112. *Cymbid-*[*ium.*
BB. Sts. naked: lvs. only at its apex ..... 113. *Gram-*[*mangis.*

30. Ionopsis Tribe.

A. Sepals free ..... 114. *Trichocen-*[*trum.*
AA. Sepala, the lateral ones, united, at least below.
B. The lip spurred ..... 115. *Rodri-*[*guezia.*
BB. The sepals spurred.
C. Spur short ..... 116. *Ionopsis.*
CC. Spur long and slender ..... 117. *Comparet-*[*tia.*

31. Ada Tribe.

A. Lvs. flat.
B. Sepals free ..... 118. *Ada.*
BB. Lateral aepals united ..... 119. *Mesos-*[*pinidium.*
AA. Lvs. cylindric ..... 120. *Quekettia.*

32. Trichopilia Tribe.

Lip rolled around the column ..... 121. *Trichopilia.*

33. Aspasia Tribe.

A. Middle lobe of lip broad ..... 122. *Aspasia.*
AA. Middle lobe of lip narrow ..... 123. *Cochlioda.*

34. Odontoglossum Tribe.

A. Lip surrounding column with 2 longitudinal calluses: blade reflexed ..... 124. *Gomeza.*
AA. Lip not as above.
B. Base of lip parallel to column and sometimes adnate to it ..... 125. *Odontoglos-*[*sum.*
BB. Lip spreading from base of column.
C. Lateral aepals united entirely; lip like dorsal sepal ..... 126. *Palum-*[*bina.*
CC. Lateral sepals free or only partly united; lip unlike dorsal sepal.
D. Sepals and petals long and much attenuated; lip entire or fiddle-shaped ..... 127. *Brassia.*
DD. Sepals and petals not much attenuated.
E. The lip entire, flat, broad ..... 128. *Miltonia.*
EE. The lip mostly 3-lobed, with warts or a cushion at base ..... 129. *Oncidium.*

35. Aerides Tribe.

A. Lip movably jointed to column.
B. Middle lobe of spurless lip flat ..... 130. *Renan-*[*thera.*
BB. Middle lobe of spurred lip compressed ..... 131. *Arach-*[*nanthe.*
AA. Lip immovably united with column.
B. Spurless.
C. Column without a foot.
D. Summit of lip laterally compressed ..... 132. *Vandopsis.*
DD. Summit of lip not compressed ..... 133. *Luisia.*
CC. Column with a foot, the lateral sepals attached to it ..... 134. *Phalænop-*[*sis.*
BB. Spurred.
C. Column without a foot.
D. Pollinia upon a single stalk.
E. Spur appendaged.
F. With a longitudinal septum ..... 135. *Sarcanthus.*
FF. With the mouth covered with a plate ..... 136. *Cleisos-*[*toma.*
EE. Spur not appendaged.
F. Stalk of the pollinia filiform.
G. Fls. firm; lip turned downwards .. 137. *Saccola-*[*bium.*
GG. Fls. fragile; lip turned upwards .. 138. *Acampe.*
FF. Stalk of the pollinia broadened upwards or throughout.
G. Spur short and broad ..... 139. *Vanda.*
GG. Spur long and slender ..... 140. *Angræcum.*
DD. Pollinia on 2 separate stalks, or these united by the gland.
E. Stalks membranous, the pollinia attached to the face.
F. Plants leafy: lip entire ..... 141. *Macroplec-*[*trum.*
FF. Plants without lvs.: lip 3-lobed .. 142. *Polyrrhiza.*
EE. Stalks slender.
F. Column bent toward the dorsal sepal ..... 143. *Listro-*[*stachys.*
FF. Column straight ..... 144. *Mystaci-*[*dium.*
CC. Column with a foot, the lateral sepals attached to it.
D. Spur curved upwards against the lip-blade ..... 145. *Aërides.*
DD. Spur straight or reflexed.
E. Lip 3-lobed ..... 146. *Camarotis.*
EE. Lip entire ..... 147. *Rhyn-*[*chostylis.*

Other orchid genera entered are: Acriopsis, Arethusa, Bromheadia, Collabium, Corysanthes, Cryptophoranthus, Cryptostylis, Diuris, Eria, Eriochilus, Geodorum, Govenia, Holothrix, Ione, Lepanthes, Lueddemannia, Megaclinium, Monomeria, Moorea, Neolauchea, Neottia, Nervilia, Neuwiedia, Notylia, Oberonia, Octomeria, Ornithidium, Ornithocephalus, Ornithochilus, Panisea, Physosiphon, Platylepis, Polycycnis, Pterostylis, Sarcochilus, Satyrium, Scaphyglottis, Schlimmia, Sievekingia, Sigmatostalix, Solenidium, Stauropsis, Stelis, Stenia, Tainia, Thecostele, Thelymitra, Trichoglottis, Trigonidium, Xylobium, and many bi- and tri-generic hybrids.

184. DIOSCOREACEÆ.

A. Fr. globose and berry-like, indehiscent ..... 1. *Tamus.*
AA. Fr. capsular, winged.
B. Caps. 1-carpelled by abortion ..... 2. *Rajania.*
BB. Caps. 3-carpelled or -lobed, winged above .... 3. *Testudi-*[*naria.*
BBB. Caps. 3-carpelled or -lobed, winged below or all around, or rarely not at all ..... 4. *Dioscorea.*

185. TACCACEÆ.

In cultivation..... *Tacca.*

186. IRIDACEÆ.

A. Fls. never more than 1 to a spathe, spicate, not fugitive.
  B. Style-branches simple, not bifid.
    C. Stamens equilateral; perianth regular.
      D. The style short: branches long and subulate.
        E. Rootstock not bulbous; roots in dense tufts, fibrous, some fleshy.... 1. *Schizostylis.*
        EE. Rootstock bulbous..... 2. *Hesperantha.*
      DD. The style longer: branches shorter and more or less broadened.
        E. The spathe-valves oblong, green or brownish upwards..... 3. *Geissorhiza.*
        EE. The spathe-valves scarious or hyaline, cut or 3-parted at apex..... 4. *Dierama.*
        EEE. The outer spathe-valve short, emarginate, membranous or papery..... 5. *Ixia.*
    CC. Stamens unilateral and arched.
      D. Foliage very hairy and plaited..... 6. *Babiana.*
      DD. Foliage not hairy and plaited.
        E. Perianth-limb irregular.
          F. Tube funnel-shaped; spathe-valves lanceolate..... 7. *Gladiolus.*
          FF. Tube cylindrical in lower half, suddenly dilated at the middle, spathe-valves oblong-lanceolate.. 8. *Antholyza.*
        EE. Perianth-limb subregular.
          F. Fls. small; no tube; segms. very acuminate..... 9. *Melas-*
          FF. Fls. larger; tube present; segms. more or less oblong. *[phærula.*
            G. Spathe valves large, green, lanceolate.....10. *Acidanthera.*
            GG. Spathe-valves small, oblong.
              H. Caps. inflated, globose.....11. *Crocosmia.*
              HH. Capa. small, oblong.....12. *Tritonia.*
            GGG. Spathe-valves scarious and deeply lacerated.....13. *Sparaxis.*
  BB. Style-branches bifid; stamens unilateral.
    C. Tube broadly funnel-shaped, with stamens inserted below the throat.....14. *Freesia.*
    CC. Tube slender with stamens inserted at the throat.....15. *Lapeyrousia.*
    CCC. Tube broadly funnel-shaped above the middle where the stamens are inserted..16. *Watsonia.*
AA. Fls. usually more than 1 to a spathe, stalked, often fugitive and opening one after another.
  B. Style-branches opposite stamens and outer perianth-segms.
    C. Stigmas transverse; style-branches have crests that overtop anthers.
      D. Inner perianth-segms. not convolute.
        E. Ovary 1-celled, with 3 parietal placentæ: rootstock digitate.....17. *Hermo-*
        EE. Ovary 3-celled. *[dactylus.*
          F. Perianth-tube usually present; filaments free: rootstock usually a rhizome, sometimes a bulb.18. *Iris.*
          FF. Perianth without a tube; filaments monadelphous: rootstock usually a tunicated corm.....19. *Morœa.*
      DD. Inner perianth-segms. convolute.
        E. Style-crests petaloid: lvs. in 2-ranked rosette, not plaited: peduncle flatteoed: rootstock not bulbous.20. *Marica.*
        EE. Style-crests large, spur-like or flattened: lvs. superposed, plaited: st. terete: rootstock bulbous .....21. *Cypella.*
          (See also Phalocallis.)
    CC. Stigmas terminal; style-branches do not overtop anthers.
      D. Perianth without any tube; inner segms small, not convolute; style-branches bifid at tip.....22. *Herbertia.*
      DD. Perianth-segms. connivent in a cup, without any spreading blade.....23. *Hydrotænia.*
      DDD. Perianth-segms. connivent in a cup, then spreading, at least the outer ones.
        E. Style-branches with 2 petal-like stigmatose crests.....24. *Homeria.*
        EE. Style-branches bifid.
          F. Ditto penicillate, i.e., shaped like an artist's brush, a dense tuft of hairs.....25. *Ferraria.*
          FF. Ditto not penicillate.
            G. Inner segms. very small; outer with a large, reflexed blade....26. *Rigidella.*
            GG. Inner and outer segms. dissimilar, various.....27. *Tigridia.*
  BB. Style-branches alternate with anthers.
    C. Rootstock not a bulb or corm.
      D. Spathes essentially 1-fid.
        E. Peduncle short, hidden; perianth with a long tube and ascending segms.....28. *Crocus.*
        EE. Peduncle long; perianth-segms. much longer than the short tube.....29. *Romulea.*
      DD. Spathes usually with more than 1 fl.....30. *Nemastylis.*
    CC. Rootstock not a bulb or corm: spathes usually more than 1-fid.
      D. Perianth-segms. unequal.
        E. Inner segms. shorter, connivent; upper stamen imperfect.....31. *Diplarrhena.*
        EE. Inner segms. obovate-cuneate; outer oblong, usually shorter; stamens all perfect.....32. *Libertia.*
      DD. Perianth-segms. subequal.
        E. Style-branches flattened and emarginate at apex: infl. a lax corymb....33. *Belemcanda.*
        EE. Style-branches subulate.
          F. Pedicels short; clusters panicled...34. *Orthosan-*
          FF. Pedicels long; clusters terminal, single or fascicled.....35. *Sisyrin-* *[thus.* *[chium.*

Other genera described are: Aristea, Cipura, Eleutherine and Ennealophus.

187. AMARYLLIDACEÆ.

A. Subterranean axis a bulb: scapose: infl. umbelloid and involucrate, or solitary..... 1. AMARYLLIS TRIBE.
AA. Subterranean axis a rhizome: st. leafy, at least at base.
  B. Plants with large, thick, fleshy, rosette-like lvs.: infl. racemose or paniculate..... 2. AGAVE TRIBE.
  BB. Plants with ordinary lvs. of small size: infl. various.
    C. Lf.-blades inverted, upper face downward: infl. an involucrate umbel..... 3. ALSTRŒMERIA
    CC. Lf.-blades normal, linear: infl. not umbelloid. [TRIBE.
      D. Plant hairy or glabrous, scapose: infl. spicate or racemose. 4. HYPOXIS TRIBE.
      DD. Plant glabrous, with leafy sts.: infl. loose, racemose or solitary; anther opening by apical pore..... 5. CONANTHERA
      DDD. Plant densely woolly with leafy sts.: infl. scorpioid: lvs. capitate..... [TRIBE. 6. CONOSTYLIS TRIBE.

I. Amaryllis Tribe.

Subtribe 1. CORONATÆ. Fl. furnished with a crown between the perianth and stamens, which is not to be confused with a staminal cup formed by the growing together of filaments.
1. *Narcissus.*

Subtribe 2. AMARYLLEÆ GENUINEÆ. Corona 0, and filaments not united into a staminal cup.

A. Anthers erect; filaments inserted at or near the base of anthers.
  B. Stamens epigynous; filaments short.
    C. The perianth-segms. all alike..... 2. *Leucojum.*
    CC. The inner segms. different, permanently connivent..... 3. *Galanthus.*
  BB. Stamens perigynous.
    C. Fls. solitary..... 4. *Cooperia.*
    CC. Fls. umbellate..... 5. *Chlidanthus.*
AA. Anthers dorsifixed, versatile.
  B. Ovules many, superposed; testa black.
    C. Fls. solitary; spathe tubular in the lower half.
      D. The fl. gaping, horizontal, bright red, 3 lower segms. convolute..... 6. *Sprekelia.*
      DD. The fls. regular, erect or suberect.
        E. Seeds globose: fls. yellow; peduncle short or long..... 7. *Sternbergia.*
        EE. Seeds flat: peduncle long..... 8. *Zephyran-* *[thes.*
    CC. Fls. umbellate; spathe 2-4-valved, and pedicels subtended by filiform bracteoles.
      D. Perianth-tube short or almost 0, rarely long in Hippeastrum.
        E. Peduncle solid: seeds few in a cell.... 9. *Lycoris.*
        EE. Peduncle hollow.
          F. Fl. often furnished with minute scales or a distinct neck at the throat: seeds many in a cell....10. *Hippeas-* *[trum.*
          FF. Fl. with a sort of corolla, which is funnel-shaped, and deeply cut, the divisions emarginate.....11. *Placea.*
      DD. Perianth-tube long.
        E. Tube broadly funnel-shaped, pulvinate at throat.....12. *Vallota.*
        EE. Tube 2-3 times longer than segms., naked at throat.....13. *Cyrtanthus.*

BB. Ovules 2, basal, collateral; testa pale.....14. *Griffinia.*
BBB. Ovules 2 or few, collateral or fascicled from the center of the placenta.
C. Fr. baccate.
D. Bulb imperfect: ovules several.....15. *Clivia.*
DD. Bulb large, tunicated: ovules 2.....16. *Hæmanthus.*
CC. Fr. capsular.....17. *Buphane.*
BBBB. Ovules few or many, superposed; seeds few, turgid, testa green.
C. Fr. indehiscent or bursting irregularly.
D. Perianth-tube long.....18. *Crinum.*
DD. Perianth-tube short.
E. Segms. broad.....19. *Amaryllis.*
EE. Segms. narrow.....20. *Ammoch-*[*aris.*
CC. Fr. a 3-valved caps.
D. Caps. top-shaped, acutely angled.....21. *Brunsvigia.*
DD. Caps. globose, obtusely angled.....22. *Nerine.*

Subtribe 3. PANCRATIEÆ. Corona 0, but stamens appendaged toward base and often united into a distinct cup.

A. Ovules superposed, many or few.
B. Lvs. broad, petioled.
C. Perianth white.
D. Ovary globose.
E. Filaments with a large tooth on each side of the anthers.....23 *Calliph-*[*ruria.*
EE. Filaments united in a distinct cup....24. *Eucharis.*
DD. Ovary 3-lobed: hybrid.....25. *Urceoch-*[*aris.*
CC. Perianth colored.
D. The perianth-tube cylindrical, suddenly dilated.....26. *Urceolina.*
DD. The perianth subcylindrical; segms. long or short.....27. *Phædran-*[*assa*
BB. Lvs. linear or ligulate, sessile.
C. Perianth colored, subcylindrical; tube long: filaments united in an entire or toothed cup.....28. *Stenomesson.*
CC. Perianth white; tube funnel-shaped; staminal cup large.....29. *Pancratium.*
AA. Ovules collateral, basal, 2–6.....30. *Hymeno-*[*callis.*
AAA. Ovules medial, 2–3.
B. Perianth funnel-shaped; segms. narrow.....31. *Vagaria.*
BB. Perianth with a slender tube and broad segms.....32. *Eurycles.*

2. Agave Tribe.

A. Lvs. thick, fleshy, usually spiny at edge and point.
B. Perianth funnel-shaped; filaments normal...33. *Agave.*
BB. Perianth rotate; filaments swollen on one side at base.....34. *Furcræa.*
AA. Lvs. comparatively thin, not spiny at edge or point.
B. Segms. short.
C. Fls. white, in a lax, simple spike; tube long, curved, subcylindrical.....35. *Polianthes.*
CC. Fls. greenish brown in a lax raceme; tube abruptly curved and dilated at middle..36. *Prochny-*
CCC. Fls. red or white, laxly spicate or racemose; tube curved, subcylindrical.....37. *Bravoa.* [*anthes.*
BB. Segms. long; tube scarcely any.
C. Fls. greenish red, in a simple or panicled raceme; segms. oblanceolate.....38. *Beschor-*
CC. Fls. bright red, in a capitulum or thyrsoid panicle; segms. narrow, falcate.....39. *Doryanthes.* [*neria.*

3. Alstrœmeria Tribe.

A. Rootstock bulbous: perianth-segms. subequal.40. *Ixiolirion.*
AA. Rootstock 0: 3 outer perianth-segms. different from 3 inner.
B. Inner segms. unequal: st. erect.....41. *Alstrœmeria.*
BB. Inner segms. equal: st. with runners or stolons.....42. *Bomarea.*

4. Hypoxis Tribe.

A. Ovary often produced into a long slender beak simulating a perianth-tube: fr. succulent, indehiscent.....43. *Curculigo.*
AA. Ovary not beaked: fr. a caps. usually circumscissile at apex.....44. *Hypoxis.*

5. Conanthera Tribe.

Stamens, 3 only, fertile.....45. *Tecophilæa.*

6. Conostylis Tribe.

Fls. irregular.....46. *Anigozan-*[*thos.*

Also in cultivation: Anoiganthus, Callipsyche, Cummingia, Cyanella, Gethyllis.

188. VELLOZIACEÆ.

A. Perianth-tube more or less extended beyond the ovary..... 1. *Barbacenia.*
AA. Perianth-tube practically none..... 2. *Vellozia.*

189. MUSACEÆ.

A. Calyx tubular, later split-spathaceous..... 1. *Musa.*
AA. Calyx of free sepals (lateral ones sometimes adnate to corolla in Heliconia).
B. Fr. a caps. loculicidally 3-valved: seeds ∞.
C. Petals 2, lateral connate..... 2. *Strelitzia.*
CC. Petals separate..... 3. *Ravenala.*
BB. Fr. indehiscent or separating into berries, the cells 1-seeded..... 4. *Heliconia.*

190. ZINGIBERACEÆ.

A. Ovary 1-celled, with 3 parietal placentæ..... 1. *Globba.*
AA. Ovary perfectly 3-celled, or at least 3-celled much above the middle; placentæ axile.
B. Lateral staminodes ample and petal-like.
C. Connective not appendaged at the base.
D. Filament short; bracts 1-fl..... 2. *Kaempferia.*
DD. Filament long; bracts 1–∞-fid..... 3. *Hedychium.*
CC. Connective appendaged at the base.
D. Spur 2-fid; lateral staminodes narrowed at base..... 4. *Roscoea.*
DD. Spurs 2; lateral staminodes connate with the petaloid filament..... 5. *Curcuma.*
BB. Lateral staminodes small, tooth-like or 0, rarely longer, narrow and adnate to labellum.
C. Filament short or very short.
D. Infl. cone-like.
E. Anther-cells divergent at apex; connective either short or produced beyond cells into an entire or 3-lobed crest..... 6. *Amomum.*
EE. Anther-cells contiguous; connective produced beyond the cells into a long, linear appendage..... 7. *Zingiber.*
DD. Infl. not cone-like.
E. Connective not produced beyond cells.
F. Anther-cells contiguous to apex.... 8. *Elettaria.*
FF. Anther-cells separate..... 9. *Renealmia.*
EE. Connective produced beyond cells into a long lanceolate, concave appendage.....10. *Burbidgea.*
CC. Filament elongated (in Costus petal-like).
D. Infl. cone-like.....11. *Costus.*
DD. Infl. not cone-like.....12. *Alpinia.*

Also in cultivation: Bamburanta, Brachychilus, Cautlea, Rhynchanthus.

191. MARANTACEÆ.

A. Ovary 1-celled after a fashion, the other cells being minute and empty.
B. Bracts narrow, convolute, inclosing the rachis..... 1. *Maranta.*
BB. Bracts and bractlets usually colored, spreading, long persistent..... 2. *Stromanthe*
BBB. Bracts spreading, deciduous..... 3. *Thalia.*
AA. Ovary usually 3-celled and 3-ovuled.
B. Corolla-tube usually short..... 4. *Phrynium.*
BB. Corolla-tube usually slender and longer..... 5. *Calathea.*

Ctenanthe is also briefly treated.

192. CANNACEÆ.

Sole genus..... *Canna.*

193. BROMELIACEÆ.

(Following Mez in DC. Monog. Phaner. vol. 9.)

A. Fr. a berry, indehiscent: ovary inferior: seeds not winged nor plumed.
B. Pollen-grains entire, not provided with pores or a longitudinal membranous fold.
C. Calyx without a tube or cup..... 1. *Bromelia.*
CC. Calyx with a tube or cup..... 2. *Cryptanthus*
BB. Pollen-grains furnished with pores.
C. Infl. immersed in a central bowl of lvs. and surrounded by an involucre formed from the reduced inmost lvs. and usually colored.

DD. Petals without ligules, connate, at least toward base.
E. The infl. simple.... 3. *Aregelia.*
EE. The infl. compound.... 4. *Nidularium.*
DD. Petals with ligules, free.... 5. *Canistrum.*
CC. Infl. not surrounded by a distinct involucre: st. or scape tall.
D. Petals furnished with 2 ligules inside.
E. Berries connate among themselves and also to the bracts and axis.... 6. *Ananas.*
EE. Berries free.
F. Sepals with long awns, or, if awnless, the ovules with very long tails.... 7. *Æchmea.*
(See also Echinostachys.)
FF. Sepals without awns or only obscurely awned: ovules obtuse.. 8. *Quesnelia.*
DD. Petals not provided with ligules inside.
E. Fls. very flat and crowded into dense cones.... 9. *Hohenbergia.*
EE. Fls. more or less loosely spicate on the branches of the infl.... 10. *Streptacalyx.*
BBB. Pollen-grains furnished with a longitudinal membranous groove.... 11. *Billbergia.*
AA. Fr. a dehiscent caps: ovary superior or nearly so.
B. Seeds winged, or appendaged: pollen grooved.
C. Ovary semi-superior.... 12. *Pitcairnia.*
CC. Ovary superior.
D. Fls. of 2 forms and dicœcious.... 13. *Hechtia.*
DD. Fls. all the same form.
E. Petals free to the very base.... 14. *Puya.*
EE. Petals coalesced toward the base.... 15. *Dyckia.*
BB. Seed with a long, plumose appendage: ovary superior.
C. Petals free.
D. The petals ligulate inside.... 16. *Vriesia.*
DD. The petals not ligulate inside.... 17. *Tillandsia.*
CC. Petals connate or intimately conglutinate. 18. *Guzmania.*
(See also Massangea.)

Catopsis and Neoglaziovia are also in cultivation.

194. LILIACEÆ.

I. Summary of Tribes.

Ignoring many exceptions.

Series 1. Anthers introrsely dehiscent: fr. usually berry-like: plant not bulbous, usually scaly at the base of the st. and leafy above, sometimes with a scaly scape.

A. Stigma not broadly peltate.
B. Ovules orthotropous or hemianatropous: "foliage" abnormal, in the Smilax Tribe 3–5-nerved but with netted veinlets; in the Asparagus Tribe lf.-shaped or needle-like "phylloclades" are present.
C. Anthers abnormal, the inner valve of each cell being so narrow that the open anther seems to be 1-celled: st. sarmentose or scandent.... 1. SMILAX TRIBE.
CC. Anthers normally 2-celled, or cells confluent at apex: st. branched or scandent.... 2. ASPARAGUS TRIBE.
BB. Ovules anatropous, rarely hemianatropous in the Luzuriaga Tribe.
C. St. shrubby and branched, or scandent.... 3. LUZURIAGA TRIBE.
CC. St. herbaceous, unbranched or sparingly branched; leafy above.. 4. SOLOMON'S SEAL [TRIBE.
CCC. Stemless herbs with lvs. clustered on the rhizome and often inclosed (together with the lateral leafless scape) by sheathing scales at the base.... 5. LILY-OF-THE-[VALLEY TRIBE.
AA. Stigma usually very broadly peltate: lvs. on the rhizome few, ample: scape very short and 1-fid. or bearing a dense spike at apex.... 6. ASPIDISTRA TRIBE.

Series 2. Anthers introrsely dehiscent: fr. loculicidally dehiscent, rarely indehiscent or berry-like: lvs. on a rhizome, or densely crowded at the apex of a caudex, or forming a bulb at the base of the scape.

A. Anthers with a pit on the back into which the filament intrudes.
B. Lvs. linear or membranous, crowded on a short rhizome: perianth cylindrical, funnel-shaped, or bell-shaped.... 7. LEMON-LILY OR [HEMEROCALLIS [TRIBE.
BB. Lvs. usually thick, fleshy or rigid, sometimes spiny: rhizome hard, often extended above ground into a woody caudex: perianth-segms. connivent or connate into a tube or sometimes with spreading tips.... 8. ALOE TRIBE.
AA. Anthers not pitted (sometimes slightly pitted in the Asphodel Tribe): lvs. not thick, and fleshy as in a century plant.
B. Rootstock, if any, rhizomatous; rhizome usually short, often very short in Asphodel Tribe, sometimes produced into a woody caudex in Dracæna Tribe (see also BB).
C. Seeds fleshy: perianth marcescent. 9. OPHIOPOGON
CC. Seeds not fleshy. [TRIBE.
D. Perianth tubular-bellshaped, connate, persistent; infl. racemose.... 10. ALETRIS TRIBE.
DD. Perianth shaped like a bell or cylinder, rarely a funnel, the segms. usually distinct, deciduous; infl. often paniculed.... 11. DRACÆNA TRIBE.
DDD. Perianth-segms. usually distinct and spreading, deciduous; infl. sparingly branched, if at all.... 12. ASPHODEL TRIBE.
BB. Rootstock bulbous as a rule: in the Onion Tribe sometimes a corm and rarely a very short rhizome; bulb usually tunicated, but in the Tulip Tribe often scaly.
C. Stemless plants with the infl. terminal on a leafy scape.
D. Infl. an umbel with an involucre of at least 2 bracts.... 13. ONION TRIBE.
DD. Infl. a raceme, or rarely a spike.... 14. SQUILL TRIBE.
CC. St. leafy, or at least with 1 lf.: fls. few or in a lax raceme.... 15. TULIP TRIBE.

Series 3. Anthers usually introrsely affixed but extrorsely dehiscent (the whole Colchicum Tribe exceptional): fr. usually a septicidal caps., rarely loculicidal or in the Medeola Tribe an indehiscent berry. Plants fibrous-rooted, rarely cormous or bulbous.

A. Fr. a berry: plant not bulbous: lvs. few, subradical or whorled on the st.... 16. MEDEOLA OR
AA. Fr. a caps. rarely, in the Bellwort Tribe, a berry. [CUCUMBER-ROOT [TRIBE.
B. Anthers introrsely dehiscent. The only tribe in Series 3 with a cormous rootstock.... 17. COLCHICUM OR
BB. Anthers extrorsely dehiscent, rarely otherwise in the Narthecium Tribe: plants not bulbous except sometimes in False Hellebore Tribe. [AUTUMN CROCUS [TRIBE.
C. St.-lvs. smaller than the radical lvs. which are either crowded or petiolate), sometimes very small or 0: caps. septicidal or loculicidal.... 18. NARTHECIUM
CC. St. leafy, herbaceous or high climbing: lvs. alternate, sessile or clasping, without sheath.... 19. BELLWORT OR [TRIBE.
CCC. St. usually tall, leafy or hardly so beyond the radical lvs.: plants not bulbous or bulbous: anthers with confluent cells, roundish-peltate after dehiscence.... 20. FALSE HELLEBORE [UVULARIA TRIBE. [OR VERATRUM TRIBE.

II. Key to the Tribes.

1. Smilax Tribe.

A. Perianth 6-parted.... 1. *Smilax.*
AA. Perianth undivided; mouth minutely toothed.. 2. *Hetera-* [*smilax.*

2. Asparagus Tribe.

A. Filaments connate into a little urn, with the anthers sessile at the mouth of the urn.
B. Anthers 3; fls. clustered on the middle of the face of the phylloclade.... 3. *Ruscus.*
BB. Anthers 6; fls. clustered on the margins, or rarely at the middle of the phylloclade.... 4. *Semele.*
BBB. Anthers 6; fls. terminal in short racemes.... 5. *Danaë.*
AA. Filaments free.... 6. *Asparagus.*

3. Luzuriaga Tribe.

A. Fls. large or rather large, solitary or few; perianth-segms. erect; ovary 1-celled with 3 parietal placentæ.
B. Lvs. 3–5-nerved: perianth-segms. of about equal length.... 7. *Lapageria.*
BB. Lvs. 1-nerved: outer perianth-segms. much smaller than inner.... 8. *Philesia.*
AA. Fls. small; perianth-segms. spreading; ovary 3-celled: lvs. with ∞ slender nerves.
B. The fls. clustered in the axils.... 9. *Eustrephus.*
BB. The fls. mostly terminating the branches.... 10. *Geitono-* [*plesium.*

4. Solomon's Seal Tribe.

A. Fls. 1–2 in the axils, rarely more, usually nodding.
B. Perianth-tube cylindrical; lobes short; style undivided, with a small stigma ..... 11. *Polygonatum.*
BB. Perianth-tube 0; segms. spreading above or from the base; style shortly or more deeply 3-fid ..... 12. *Streptopus.*
AA. Fls. in a terminal raceme or panicle.
B. Floral parts in 3's ..... 13. *Smilacina.*
BB. Floral parts in 2's ..... 14. *Mainthemum.*

5. Lily-of-the-Valley Tribe.

A. Fls. racemose, nodding; perianth subglobose; lobes shorter than tube ..... 15. *Convallaria.*
AA. Fls. spicate, far apart; perianth-tube cylindrical; lobes recurved-spreading ..... 16. *Reineckia.*

6. Aspidistra Tribe.

A. Fls. 4-merous; stigma very large, roundish-peltate, undivided ..... 17. *Aspidistra.*
AA. Fls. 3-merous; stigma broadly peltate, 3-lobed. 18. *Rohdea.*

7. Lemon-Lily, or Hemerocallis Tribe.

A. Fls. erect; stamens affixed at apex of tube: lvs. long and narrow.
B. Perianth funnel-shaped, the cylindrical tube shorter than the lobes; panicles few-fld ..... 19. *Hemerocallis.*
BB. Perianth with subincurved segms. loosely connivent above the top-shaped tube; panicles much branched ..... 20. *Phormium.*
AA. Fls. pendulous.
B. Stamens affixed at middle of tube: lvs. long and narrow: perianth-tube swollen above; lobes short ..... 21. *Blandfordia.*
BB. Stamens often hypogynous.
C. Lvs. petioled, usually broad: fls. racemose; perianth funnel-shaped; tube short or long ..... 22. *Funkia.*
CC. Lvs. long and narrow: fls. spicate; perianth a long narrow tube with short lobes ..... 23. *Kniphofia.*

8. Aloe Tribe.

A. Perianth-segms. strongly connate into a tube which is swollen at the base; segms. free at apex; stamens included in tube ..... 24. *Gasteria.*
AA. Perianth-segms. coherent or connivent to the very apex in a tube, or barely spreading at the very apex; stamens usually exserted ..... 25. *Aloe.*
AAA. Perianth-segms. coherent or connivent, stellate-spreading at apex; stamens a little shorter than perianth ..... 26. *Apicra.*
AAAA. Perianth usually incurved, the segms. cohering or connivent, at the apex recurved and spreading somewhat as if 2-lipped; stamens not exceeding perianth ..... 27. *Haworthia.*
AAAAA. Perianth of Aloe, but stamens a little shorter than the perianth ..... 28. *Lomatophyllum.*

9. Ophiopogon Tribe.

A. Perianth-tube long and slender; filaments normal ..... 29. *Sansevieria.*
AA. Perianth more or less erect or spreading above the ovary; filaments shorter than the linear anthers; style longish ..... 30. *Ophiopogon.*
AAA. Perianth spreading from base of ovary; filaments about as long as the oblong anthers ..... 31. *Liriope.*

10. Aletris Tribe.

One genus cultivated ..... 32. *Aletris.*

11. Dracæna Tribe.

A. Ovary 1-celled; cells 3-ovuled ..... 33. *Dasylirion.*
AA. Ovary 3-celled.
B. Cells 1-ovuled ..... 34. *Dracæna.*
BB. Cells 2-ovuled ..... 35. *Nolina.*
BBB. Cells ∞-ovuled.
C. Fls. racemose ..... 36. *Hesperocallis.*
CC. Fls. panicled.
D. Anthers small, sessile on a club-shaped filament; perianth subglobose or bell-shaped; segms. hardly connate at base ..... 37. *Yucca.*
DD. Anthers dorsifixed on normal or flattened filaments; perianth cylindrical or narrowly bell-shaped, with a short tube ..... 38. *Cordyline.*

12. Asphodel Tribe.

Summary of Subtribes.

A. Anthers dorsifixed, versatile.
B. Subtribe 1. Euasphodeleæ. Plant not bulbous: lvs. crowded at base of st.; cauline lvs. smaller, when present.
BB. Subtribe 2. Lomandreæ. Plant not bulbous: lvs. grass-like: fls. in spikes.
BBB. Subtribe 3. Chlorogaleæ. Plant bulbous: lvs. few.
AA. Anthers erect, affixed at or near the base.
B. Subtribe 4. Bowieæ. Lvs. few, from a thick tuber or fleshy bulb, quickly vanishing before or at anthesis.
BB. Lvs. numerous, crowded at base of st. or sometimes in Subtribe 5 arranged along st.
C. Subtribe 5. Anthericeæ. Lvs. not 2-ranked.
CC. Subtribe 6. Dianelleæ. Lvs. 2-ranked.

Subtribe 1. Euasphodeleæ.

A. Ovules 2 in a cell.
B. St. or scape leafless.
C. Anthers pitted where the filament is inserted; fls. yellow ..... 39. *Asphodelus.*
CC. Anthers not pitted ..... 40. *Bulbinella.*
(Consult Chrysobactron.)
BB. St. more or less leafy: fls. usually white ..... 41. *Asphodeline.*
AA. Ovules ∞ in a cell.
B. Anthers pitted; filaments glabrous ..... 42. *Paradisea.*
BB. Anthers not pitted; filaments long bearded ..... 43. *Bulbine.*

Subtribe 2. Lomandreæ.

In cultivation ..... 44. *Xanthorrhœa.*

Subtribe 3. Chlorogaleæ.

A. Perianth-segms. 3-nerved ..... 45. *Chlorogalum.*
AA. Perianth-segms. 1-nerved ..... 46. *Hastingsia.*

Subtribe 4. Bowieæ.

Lvs. linear, vanishing before anthesis: bulb tuber-like ..... 47. *Bowiea.*

Subtribe 5. Anthericeæ.

A. Infl. clustered down among the radical lvs. on a very short st. ..... 48. *Leucocrinum.*
AA. Infl. on a scape, simple or with few branches, racemose or spicate.
B. Stamens 6nally as long as the perianth or longer; raceme long, simple and dense ..... 49. *Eremurus.*
BB. Stamens shorter than perianth.
C. Caps. with hardly prominent angles ..... 50. *Anthericum.*
CC. Caps. 3-cornered or 3-winged ..... 51. *Chlorophytum.*

Subtribe 6. Dianelleæ.

Filaments fleshy or thickened at apex or middle ..52. *Dianella.*

13. Onion Tribe.

A. Rootstock a short rhizome, with clusters of root-fibers ..... 53. *Agapanthus.*
AA. Rootstock a tunicated bulb or corm.
B. Perianth salver-shaped or urn-shaped.
C. Stamens 6; perianth-tube cylindrical.
D. Tube often crowned at throat with 3–6 scales; stamens included inside the tube in 2 series ..... 54. *Tristagma.*
DD. Tube constricted at the mouth by a scarcely noticeable ring; stamens exserted at mouth of tube; filaments very short ..... 55. *Milla.*
CC. Stamens 3, affixed at throat.
D. Perianth-tube subglobose, constricted at mouth; stamens alternate with a like number of staminodes ..... 56. *Strophiolirion.*
DD. Perianth-tube broadly cylindrical, shortly 6-saccate at base; stamens with a like number of staminodes connate into a spurious corona behind the anthers ..... 57. *Brevoortia.*
BB. Perianth funnel-shaped or bell-shaped; lobes as long as the tube or longer.
C. Filaments connate into a tube; stamens 6, affixed to throat.
D. Tube about as long as lobes ..... 58. *Androstephium.*
DD. Tube much shorter than lobes ..... 59. *Bessera.*
CC. Filaments free, normal or very short; perfect stamens 6 or 3, affixed to throat or tube.
D. Pedicels articulated at apex ..... 60. *Brodiæa.*

DD. Pedicels not articulated at apex.....61. *Triteleia.*
BBB. Perianth wheel-shaped or bell-shaped; segms. connate at the base into a ring or cup.
C. Rootstock a fibrous-tunicated corm.
D. Filaments dilated at base into truncate scales surrounding ovary.....62. *Bloomeria.*
DD. Filaments slightly dilated below the middle.....63. *Muilla.*
CC. Rootstock a tunicated bulb.
D. Alliaceous odor absent; perianth-segms. connate at base or to the middle.....64. *Nothoscordum.*
DD. Alliaceous odor nearly if not quite always present; perianth-segms. distinct or barely united at base in a ring.....65. *Allium.*

14. Squill Tribe.

A. Perianth-segms. distinct, or united only at the very base.
B. Seeds strongly compressed; ovules numerous.
C. The outer segms. of the persistent perianth spreading, the inner a little shorter, erect, connivent at apex and variously crested.....66. *Albuca.*
CC. The segms. of the deciduous perianth subequal, connivent into a bell, or spreading.....67. *Urginea.*
BB. Seeds obovoid or globose, not flattened or angled; ovules 2–∞ in a cell.
C. Infl. a long dense raceme, bearded at the apex by empty bracts, which may be herbaceous or colored.....68. *Eucomis.*
CC. Infl. not as in C.
D. Nerves of perianth-segms 1.....69. *Scilla.*
DD. Nerves of perianth-segms. 3–∞.....70. *Camassia.*
DDD. Nerves of perianth segms. obscure.....71. *Ornithogalum.*
AA. Perianth-segms. united into a tube or bell.
B. Ovules ∞, usually numerous.
C. Seeds strongly compressed or angled.
D. The outer lobes spreading; inner ones erect and shorter.....72. *Dipcadi.*
DD. The lobes all spreading and subequal, or the inner ones a little wider.....73. *Galtonia.*
CC. Seeds obovoid or globose.....74. *Lachenalia.*
BB. Ovules 2–6 in a cell, rarely more; seeds not flattened or angled.
C. Lobes very short, tooth-like, much shorter than tube.
D. Perianth cylindrical.....75. *Veltheimia.*
DD. Perianth urn-shaped, constricted at throat.....76. *Muscari.*
CC. Lobes considerably longer than the bell-shaped tube; fls. few, in a lax raceme.
D. Filaments erect, not connate, all or only alternate ones dilated and petal-like.77. *Chionodoxa.*
DD. Filaments connate into a sort of cup which is produced beyond the anthers into a cone.....78. *Puschkinia.*
CCC. Lobes shorter than the tube or about as long, sometimes a trifle longer; filaments normal or dilated at base.....79. *Hyacinthus.*

15. Tulip Tribe.

A. Caps. septicidally dehiscent or 3-parted: fls. erect or pendulous; outer perianth-segms. usually narrower or smaller; inner ones pitted.....80. *Calochortus.*
(Consult also Cyclobothra.)
AA. Caps. loculicidally dehiscent.
B. Anthers dorsifixed, versatile; fls. nodding or pendulous, rarely erect; claw of segms. usually furnished with a nectariferous groove.....81. *Lilium.*
BB. Anthers basifixed, erect; filament usually intruded.
C. Fls. usually erect; perianth bell-shaped or somewhat funnel-shaped; segms. often spotted near the base, not pitted.....82. *Tulipa.*
CC. Fls. nodding or pendulous.
D. Perianth bell-shaped; segms. usually furnished with a pit or nectar-bearing spot above the base.....83. *Fritillaria.*
DD. Perianth-segms. narrow, recurved or reflected from the middle or almost from the base.....84. *Erythronium.*

16. Medeola, or Cucumber-Root Tribe.

A. Foliage at base of st.; lvs. few, stalked or contracted into a sheath: fls. in a long-peduncled umbel, rarely solitary.....85. *Clintonia.*
AA. Foliage whorled at top of st.
B. Lvs. 3: fl. solitary, 3-merous.....86. *Trillium.*
BB. Lvs. 4–∞: fls. solitary, 4–∞-merous.....87. *Paris.*
AAA. Foliage whorled at middle of st. with 3 smaller lvs. at the top surrounding the umbel.....88. *Medeola.*

17. Colchicum, or Autumn-Crocus Tribe.

A. Perianth-tube entire; styles 3, distinct from the base..... 89. *Colchicum.*
AA. Perianth-segms. with distinct claws, connivent into a tube.
B. Styles 3, distinct from base..... 90. *Merendera.*
BB. Style entire inside the tube, 3-fid at apex.... 91. *Bulbocodium.*

18. Narthecium Tribe.

A. Caps. loculicidally dehiscent.
B. Style undivided..... 92. *Narthecium.*
BB. Styles 3..... 93. *Zerophyllum.*
AA. Caps. aepticidally dehiscent or parted.
B. Fls. few at apex of scape; style undivided.... 94. *Heloniopsis.*
BB. Fls. in a dense raceme; styles 3, very short.. 95. *Helonias.*

19. Bellwort, or Uvularia Tribe.

A. Fr. an indehiscent berry..... 96. *Disporum.*
AA. Fr. a septicidal caps..... 97. *Tricyrtis.*
AAA. Fr. (when known) a loculicidal caps.
B. Fls. terminal, pendulous.
C. Lvs. perfoliate: seeds covered by a thin white aril..... 98. *Uvularia.*
CC. Lvs. sessile: seeds have a swollen, spongy, brown ridge..... 99. *Oakesia.*
BB. Fls. axillary, or long-pedicelled in the axils.
C. Plants are climbers.
D. Perianth-segms. spreading, usually wavy or crisped.....100 *Gloriosa.*
DD. Perianth-segms. distinct, suberect, more or less connivent and bell-shaped.....101. *Littonia.*
CC. Plants not climbers: periath urn-shaped; lobes very short.....102. *Sanderonia.*

20. False Hellebore or Veratrum Tribe.

A. Seeds membranous-winged nearly all the way around: sts. leafy.
B. Lvs. narrow or long-stalked: perianth-segms. distinctly clawed.....103. *Melanthium.*
BB. Lvs. usually broad, plaited, veiny, contracted into a sheath, not distinctly stalked: perianth-segms. a trifle contracted at the base.....104. *Veratrum.*
AA. Seeds narrow, angled, hardly winged: lvs. radical or crowded at base of st., linear or rarely sublanceolate.
B. Stamens much shorter than perianth; perianth more or less bell-shaped.....105. *Stenanthium.*
BB. Stamens a little shorter than perianth; perianth flattened out.....106. *Zygadenus.*

Other genera described are: Acrospira, Alectorurus, Androcymbium, Arthropodium, Astelia, Chamælirium, Dipidax, Drimia, Leucocoryne, Massonia, Oligobotrya, Peliosanthes, Thysanotus, Tofieldia, Tupistra, and Tulbaghia.

195. PONTEDERIACEÆ.

A. Perianth funnel-shaped.
B. Ovary by abortion 1-celled, 1-ovuled..... 1. *Pontederia.*
BB. Ovary 3-celled, many-ovuled..... 2. *Eichhornia.*
AA. Perianth salver-shaped..... 3. *Heteranthera.*

196. COMMELINACEÆ.

A. Fr. indehiscent.
B. Pericarp hard and brittle..... 1. *Pollia.*
BB. Pericarp succulent or fleshy..... 2. *Palisota.*
AA. Frs. loculicidally dehiscent.
B. Fls. with 3 perfect stamens, and 3 or fewer staminodes.
C. Anther-cells parallel and contiguous.
D. Ovary 3-celled; 2 anterior cells 1–2-ovuled; posterior 1-ovuled, empty or wanting..... 3. *Commelina.*
DD. Ovary 2–3-celled; cells usually 2–∞-ovuled..... 4. *Aneilema.*
CC. Anthers, with variously petaloid connective cells spirally twisted into numerous gyres..... 5. *Cochliostema.*
BB. Fls. with 6 stamens, rarely 5, all perfect; no staminodes.
C. Anther-cells dehiscing by a terminal pore. 6. *Dichorisandra.*
CC. Anthers otherwise dehiscent.
D. Connective transversely or divaricately 2-lobed..... 7. *Zebrina.*
DD. Connective not 2-lobed as in D.
E. Ovary-cells 2–5-ovuled.

FF. Cymes fascicle-formed, with the very short rachis contracted into a receptacle, sessile inside the base of the complicate floral lvs. or variously paniculate..... 8. *Trades-[cantia.*
FF. Cyme terminal, pedunculate with 2–3 longish branches secund-fld. from base..... 9. *Tinantia.*
EE. Ovary cells 1-ovuled.....10. *Rhœo.*

197. JUNCACEÆ.

A. Ovary 1-celled, or more or less perfectly 3-celled; placentæ or cells ∞-ovuled..... 1. *Juncus.*
AA. Ovary 3-celled; cells 2- or few-ovuled..... 2. *Prionium.*

198. PALMACEÆ.

A. Lf.-segms. infolded in vernation: spadices interfoliaceous.
B. Fls. dicœious.
C. Lvs. pinnatisect; segms. acuminate: spathe solitary; ovary of 3 distinct carpels, only 1 maturing: seed deeply grooved ventrally umbilicate, embryo dorsal..... 1. PHŒNIX TRIBE.
CC. Lvs. plaited in a fan-shaped fashion, roundish, semi-orbicular or wedge-shaped, split: spathes numerous; ovary entire or 3-lobed, 3-celled, with erect ovules: seeds with a mere dot of a hilum: raphe ventral..... 2. CORYPHA TRIBE.
BB. Fls. usually hermaphrodite: lvs. much like those of Corypha Tribe: spathes numerous; ovary entire, 3-lobed, with ascending ovules: seeds with diffused hilum..... 3. BORASSUS TRIBE.
AA. Lf.-segms. folded back in vernation.
B. Seeds adherent to the endocarp; hilum diffused; embryo opposite pore; spadices interfoliaceous; fls. usually monœcious in the same spadix, the lower ones in 3's with the middle one pistillate..... 4. COCOS TRIBE.
BB. Seed umbilicate.
C. Raphe dorsal; embryo ventral: spadices terminal or axillary; fls. polygamo-monœcious..... 5. LEPIDOCARYA [TRIBE.
CC. Raphe ventral; embryo dorsal.... 6. ARECA TRIBE.

1. Phœnix Tribe.

The only genus..... 1. *Phœnix.*

2. Corypha Tribe.

A. Style or stigma basilar in fr.: endosperm equable.
B. The style short; embryo terminal. Palms fruit once and die..... 2. *Corypha.*
BB. The style elongated.
C. Embryo dorsal..... 3. *Sabal [(Inodes).*
CC. Embryo sub-basilar..... 4. *Washing-[tonia.*
AA. Style or stigma terminal in fruit.
B. Perianth of imbricate petals or corolla-segms.
C. Fls. polygamo-dicœious; stigmas sessile, distinct; embryo dorsal.
D. Endosperm ruminate..... 5. *Chamærops.*
DD. Endosperm equable..... 6. *Rhapido-[phyllum.*
CC. Fls. hermaphrodite; styles long, distinct.
D. Filaments free..... 7. *Acantho-[rhiza.*
DD. Filaments connate into a tube..... 8. *Trithrinax.*
BB. Perianth of valvate petals or corolla-lobes (see also BBB).
C. Fls. dicœcious; corolla 3-toothed; anthers extrorsely dehiscent..... 9. *Rhapis.*
CC. Fls. polygamo-monœcious; carpels distinct; stigmas distinct, sessile: endosperm equable, ventrally grooved; embryo dorsal.....10. *Trachy-[carpus.*
CCC. Fls. hermaphrodite.
D. Embryo dorsal; endosperm equable: carpels slightly cohering or in Livistona sometimes distinct.
E. Spadix-branches not sheathed style single, short, 3-cornered.....11. *Brahea.*
EE. Spadix rachis sheathed; carpels 3-cornered; style single, thread-like..12. *Licuala.*
EEE. Spadix-branches naked or lower ones bracted; carpels globose; styles short, distinct or cohering.....13. *Livistona.*
DD. Embryo, sub-basilar: rachis of spadix sheathed.
E. Endosperm ruminate: carpels 3, distinct at base; style single, short, 3-grooved.....14. *Copernicia.*
EE. Endosperm equable.
F. Corolla-tube persistent; segms. deciduous; ovary 3-cornered or 3 lobed, narrowed into a style..15. *Pritchardia.*
FF. Corolla otherwise.
G. Carpels free at base; style single, slender, elongated.....16. *Serenæa.*
GG. Carpels slightly cohering; style single, short, 3-grooved.....17. *Erythea.*
BBB. Perianth minute 6-fid or obsolete.....18. *Thrinax* (and *Coccothrinax*).

3. Borassus Tribe.

A. Stamens 6.
B. Fls. numerous in the cavities of the spadix...19. *Borassus.*
BB. Fls. solitary in the cavities.....20. *Hyphæne.*
AA. Stamens numerous.
B. Fls. numerous in cavities.....21. *Lodoicea.*
BB. Fls. solitary in cavities.....22. *Latania.*

4. Cocos Tribe.

A. Palms armed with prickles: fr. 1-seeded; endocarp 3-porous at or above the middle.
B. Pistillate fls. with petals united for a considerable distance; staminate fls. smaller: endocarp bony.
C. Staminate fls. not immersed in spadix: lf.-segms. acuminate.....23. *Bactris.*
CC. Staminate fls. immersed in cavities of spadix: lf.-segms. premorse.....24. *Astro-[caryum.*
BB. Pistillate fls. with petals connate only at base.
C. Staminate fls. immersed; anthers large, inserted: lf.-segms. acuminate.....25. *Acrocomia.*
CC. Staminate fls. not immersed; anthers included: lf.-segms. wedge-shaped, premorse.....26. *Martinezia.*
AA. Palms unarmed.
B. Endocarp 3-porous above middle: fr. 1–3-seeded.....27. *Elæis.*
BB. Endocarp bony and, except in Jubæa, 3–6-porous toward base: fr. 1–∞-seeded.
C. Spadix simple.....28. *Diplothe-[mium.*
CC. Spadix simply branched.
D. Number of stamens 6: fr. 1-seeded (in Scheelea sometimes 2–3-seeded).
E. Petals minute, much smaller than exserted stamens of staminate fls...29. *Maxi-[miliana.*
EE. Petals lanceolate; stamens included..30. *Cocos.*
EEE. Petals shaped like a long club, or cylindrical; stamens shorter.....31. *Scheelea.*
DD. Number of stamens 10–24 or more; petals of staminate fls. lanceolate; stamens included; anther-cells connate.
E. Fr. 2–6-seeded.....32. *Attalea.*
EE. Fr. 1-seeded; the endocarp 3-porous at the middle or a little lower.....33. *Jubæa.*

5. Lepidocarya Tribe.

A. Lvs. fan-shaped: ovary perfectly 3-celled.....34. *Mauritia.*
AA. Lvs. equally pinnatisect: ovary imperfectly 3-celled: spadices axillary.
B. Palms fruit once and die.....35. *Plectocomia.*
BB. Palms fruit more than once; usually climbers.
C. Spathes solitary, deciduous: lf.-segms. rhombic; nerves fan-shaped.....36. *Ceratolobus.*
CC. Spathes numerous, persistent: lf.-segms. acuminate; nerves parallel.
D. Spadices contracted; spathes cymbiform, beaked, long-persistent, the 2 lower ones forming an involucre for the others.....37. *Dæmono-[rops.*
DD. Spadices diffused, or, if contracted, the spathes are flat and persistent only during anthesis.....38. *Calamus.*

6. Areca Tribe.

Key to Subtribes;

A. Petals of the pistillate fls. valvate throughout nearly their whole length; spadices interfoliaceous; spathes 2 or more; ovary entire, 3-celled..... 1. CARYOTIDEÆ.
AA. Petals of the pistillate fls. overlapping or valvate only at apex, very rarely valvate throughout.
B. Spadices infrafoliaceous.
C. Stigmas terminal in fr.; ovary entire, 1-celled.
D. Staminate fls. unsymmetrical; sepals usually small and not imbricate..... 2. EUARECEÆ.

DD. Staminate fls. symmetrical; sepals usually roundish and widely overlapping..... 3. PTYCHOSPERMEÆ.
CC. Stigmas usually excentric or lateral on ovary, entire or 3-lobed: lf.-segms. acuminate.
D. Spathes 2; ovary entire..... 4. ONCOSPERMEÆ.
DD. Spathes numerous: lf.-segms. wedge-shaped.
E. Ovary entire; younger spadices horn-shaped..... 5. IRIARTEEÆ.
EE. Ovary deeply 3-lobed, with large stigmas; spadices club-shaped..... 6. WETTINIEÆ.
BB. Spadices nearly alwaya interfoliaceous.
C. Stigmas terminal on fr., rarely basal.
D. Ovary 1-celled; spadix simple, with monœcious fls. immersed in cavities..... 7. LINOSPADICEÆ.
DD. Ovary 3-celled, imperfectly so in Subtribe 8.
E. Fr. globose: spadix paniculately branched, the fls. dicœcious and pedicelled..... 8. CEROXYLEÆ.
EE. Fr. elongated: spadix subdigitately branched, the fls. monœcious and not immersed..... 9. MALORTIEÆ.
CC. Stigmas lateral or basal on fr., rarely terminal; ovary entire.
D. Fls. not immersed in cavities.
E. Spathes 2; all the fls. or the lower ones in 3's; ovary 1–3-celled.....10. IGUANUREÆ.
EE. Spathes numerous; ovary 3-celled; spadices inter- and infrafoliaceous; fls. usually dicœcious, without bracta or bractlets; perianth rather fleshy or leathery.....11. CHAMÆDOREÆ.
DD. Fls. immersed in cavities, monœcious or dicœcious, compressed; perianth glumaceous; style often elongated, terminal or lateral.....12. GEONOMEÆ.

Subtribe 1. Caryotideæ.

A. Lvs. bipinnatisect: endosperm ruminate: staminate fls. with 3 sepals and stamens.....39. *Caryota.*
AA. Lvs. pinnatisect: endosperm equable.
B. Stamens 6; calyx of staminate fls. tubular, truncate.....40. *Wallichia.*
BB. Stamens ∞.
C. Calyx of staminate fls. cup-shaped, 3-lobed.....41. *Didymos-* [*perma.*
CC. Calyx of staminate fls. of 3 sepals.....42. *Arenga.*

Subtribe 2. Euareceæ.

A. Ovule basal, erect.
B. Endosperm ruminate.
C. Stamens 3 or 6; staminate fls. minute, numerous, solitary or in pairs, on branches of spadix; pistillate fls. much larger, solitary toward base of branches.43. *Areca.*
CC. Stamens numerous; fls. in 3's, the middle one pistillate, arranged in 2, 4 or 6 ranks.....44. *Pinanga.*
BB. Endosperm equable: stamens 6; fls. in 3's, the middle one pistillate, arranged in 4 ranks...45. *Kentia.*
AA. Ovule parietal, more or less pendulous.
B. Fls. arranged in 4 ranks on branches of spadix.....46. *Hydriastele.*
BB. Fls. arranged spirally on branches of spadix. (All "sepals" mentioned under BB refer to sepals of staminate fls. except when otherwise stated.)
C. Pistillate fls. much larger than staminate; sepals papery, connate at base.....47. *Veitchia.*
CC. Pistillate fls. not larger than staminate.
D. Length of sepals far surpassing petals; sepala narrow.....48. *Nenga.*
DD. Length of sepals not exceeding petals.
E. The sepals overlapping.
F. Sepals triangular-orbicular; atamens numerous; filaments short.49. *Kentiopsis.*
FF. Sepals small, keeled; stamens 9–24; filaments inflexed at apex.....50. *Archonto-* [*phœnix.*
EE. The sepals not overlapping.
F. Filaments inflexed at apex.
G. Sepala awl-shaped or lanceolate; stamens 6–12; pistillate fls. with short petals valvate at [*stylis.* apex.....51. *Rhopalo-*
GG. Sepala small, acute; stamens 6; pistillate fls. with petals a little longer than the sepals.....52. *Dictyo-* [*sperma.*
FF. Filaments normal; sepals narrowly lanceolate; stamens 9–12; pistillate fls. with petals like the sepals.....53. *Hedyscepe.*

Subtribe 3. Ptychospermeæ.

A. Endosperm ruminate.
B. Stamens 20–30.....54. *Ptycho-* [*sperma.*
BB. Stamens 6.....55. *Rhopalo-* [*blaste.*
AA. Endosperm equable.
B. Lf.-segms. obliquely premorse: stamens numerous.....56. *Drymo-* [*phlœus.*
BB. Lf.-segms. narrowed at apex, or in Cyrtostachys entire or sometimes obliquely 2-toothed.
C. Stamens 6–15; pericarp slightly fibroua, smooth inside.....57. *Cyrtostachys.*
CC. Stamens 6; pericarp thick, granular, fibrous inside.....58. *Cypho-* [*phœnix.*

Subtribe 4. Oncospermeæ.

A. Staminate fls. symmetrical; sepals broad and much overlapping; atigmas on fr. excentric or lateral, or in Cyphosperma subterminal.
B. Perianth of pistillate fls. enlarged after anthesis.
C. Pericarp grumose and fibrous.....59. *Clinostigma.*
CC. Pericarp thin, leathery or bony.....60. *Cypho-* [*sperma.*
BB. Perianth not changed after anthesis.....61. *Microkentia.*
AA. Staminate fls. unsymmetrical; sepals small or narrow, not imbricate or only slightly so; atigmas lateral on fr. or basal.
B. Petals of pistillate fls. connate at base, valvate above.
C. Calyx of staminate fls. united at base.....62. *Oreodoxa.* (Incl. Roystonea.)
CC. Calyx with 3 distinct sepals.....63. *Acrista.*
BB. Petals free.
C. Anthers erect.....64. *Oncosperma.*
CC. Anthers versatile.
D. Fr. globose: palms unarmed.....65. *Euterpe.*
DD. Fr. minute: palms spiny.....66. *Acantho-* [*phœnix.*

Subtribe 5. Iriarteeæ.

Stamens 9–15; stigmas terminal or nearly so in fr.: lf.-segma. turned in every direction.....67. *Iriartea.*

Subtribe 6. Wettinieæ.

No representativea known to be cultivated in America.

Subtribe 7. Linospadiceæ.

A. Anthera basifixed, erect.
B. Stamens 6, 10, or 12; pistillate fls. have ∞ staminodes: lf.-segma. premorse.....68. *Bacularia.*
BB. Stamens very numerous; pistillate fls. have no staminodes: lf.-segms. acuminate.....69. *Howea.*
AA. Anthers dorsifixed, versatile; staminodes in pistillate fls. 6–9: lf.-segms. acuminate.....70. *Linospadix.*

Subtribe 8. Ceroxyleæ.

Stamens 9–15: fr. with basal stigmas.....71. *Ceroxylon.*

Subtribe 9. Malortieæ.

Not cultivated in America.

Subtribe 10. Iguanureæ.

A. Stigmas excentric or lateral on fr.....72. *Heterospathe.*
AA. Stigmas basal or nearly so on fr.
B. Stamens 15–20; ovary 1-celled: palm armed.....73. *Stevensonia.*
BB. Stamens 6, with didymous anthers.
C. Ovary 1-celled: palm armed.....74. *Verschaf-* [*feltia.*
CC. Ovary 3-celled: palm unarmed.....75. *Dypsis.*

Subtribe 11. Chamædoreæ.

A. Fls. dicœcious or monœcious in different spadices, spirally arranged.....76. *Chamæ-* [*dorea.*
AA. Fls. monœcious in the same spadix.
B. The fls. arranged in elongated heaps or clusters.
C. Infl. from among the lvs.....77. *Gaussia.*
CC. Infl. from below the lvs.....78. *Hyophorbe.*
BB. The fls. sparse, solitary or in pairs.....79. *Rescheria.*

Subtribe 12. Geonomeæ.

A. Base of the ovary included in the disk.
B. Anthera arrow-shaped.....80. *Calyptrogyne.*
BB. Anthera with long separate pendulous cella..81. *Geonoma.*
AA. Disk 0: many-stemmed palms of India.....82. *Bentinckia.*

Imperfectly Known Genera of Palms.

83. *Balaka* is a member of the Areca Tribe and probably belongs between Ptychosperma and Drymophlœus, differing from those genera as indicated in the article Balaka.
84. *Bismarckia* is a member of the Borassus Tribe.
85. *Chrysalidocarpus* is a well-known member of the Areca Tribe of doubtful affinity.
86. *Exorrhiza* is a member of the Areca Tribe, Subtribe Euarceæ.
87. *Nipa* is a member of the Areca Tribe but of uncertain affinity. Its nearest horticultural relative is Phœnix.
88. *Phytelephas* is a well-known member of the Areca Tribe but of doubtful affinity.
89. *Pseudophœnix* is a member of the Areca Tribe which probably belongs in the Subtribe Chamædoreæ, near Hyophorbe.
90. *Ptychoraphis* is a member of the Areca Tribe which probably comes after Ptychosperma.
91. *Ranevea* is known only in the juvenile state and is conjectured to be near to Hyophorbe.

The following genera are also treated: Acoelorraphe, Cyphokentia, Desmoncus, Eremospatha, Hyospathe, Manicaria, Metroxylon, Microphœnix, Neonicholsonia, Œnocarpus, Pigafetta, Ptychococcus, Synechanthus, Teysmannia, Welfia and Zalacca.

199. LEMNACEÆ.

Floating plants with roots: fls. inserted on marginal cracks of the frond; stamens 1–2; anthera 2-celled..... *Lemna.*

200. PANDANACEÆ.

A. Ovulea solitary in carpels..... 1. *Pandanus.*
AA. Ovules many in the locules..... 2. *Freycinetia.*

201. CYCLANTHACEÆ.

A. Plants with watery juice..... 1. *Carludovica.*
AA. Plants with milky juice..... 2. *Cyclanthus.*

202. TYPHACEÆ.

The only genus..... *Typha.*

203. ARACEÆ.

A. Perianth 0 (except female fls. of Peltandra).
B. Fls. monœcious (in Arisæma sometimes dioecious).
C. Spadix appendaged (except in Pistea).
D. The male and female infl. contiguous with no neutral organs between: ovules anatropous or semi-anatropous 1. *Amorphophallus.*
DD. The upper fls. males, lower ones females: ovulea orthotropous.
E. The spadix free from the spathe or adnate at the base.
F. Male fls. sparse: lvs. and fls. appear together.
G. Tube of spathe with counate margins; male fls. with 1 stamen; anthers horseshoe-shaped..... 2. *Arisarum.*
GG. Tube of spathe convolute; fls. usually dioecious; males with 2–5 stamens..... 3. *Arisæma.*
FF. Male fls. dense: lva. often appear before fls.
G. Tube of spathe with connate margins.
H. Ovule solitary: lvs. entire..... 4. *Biarum.*
HH. Ovulea 2–4: lvs. pedatisect.... 5. *Sauromatum.*
GG. Tube of spathe convolute.
H. Ovulea ∞, parietal, in 2 series. 6. *Arum.*
HH. Ovulea few, inserted at base and apex of cell.
I. Male and female fls. remote; appendix of spadix hairy.. 7. *Helicodiceros.*
II. Male and female fls. contiguous..... 8. *Dracunculus.*
EE. The spadix not appendaged, adnate to spathe on back: aquatic plant... 9. *Pistia.*
EEE. The tube of spathe closed at mouth by dilation of spadix or else divided into 2 cells.
F. Tube closed at throat.....10. *Pinellia.*
FF. Tube 2-celled.....11. *Ambrosinia.*
CC. Spadix not appendaged (rarely with a naked appendage or endowed with neutral organs); upper fls. malea, lower ones females.
D. Stamens connate in a prismatic or peltate body.
E. Plants are climbing shrubs.
F. Ovaries distinct, 2–10-celled.....12. *Philodendron.*
FF. Ovariea coherent, 1–2-celled.....13. *Syngonium.*
EE. Plants are herbs, not climbing
F. The ovules orthotropous or nearly so; micropyle superior.
G. Ovules numerous in 2 series on 3–5 parietal placentæ.....14. *Colocasia.*
GG. Ovules few, basal.....15. *Alocasia.*
GGG. Ovules 1 or few, subparietal: distinguished by ovary immersed in a carp and embryo not albuminous.....16. *Peltandra.*
FF. The ovules anatropous or semi-anatropous; micropyle inferior.
G. Ovaries distinct or slightly coherent.....17. *Caladium.*
GG. Ovaries distinct below, above thick, dilated and grown together.....18. *Xanthosoma.*
GGG. Ovary 2–5-celled.....19. *Dieffenbachia.*
DD. Stamens distinct.
E. Fr. not included by tube of spathe: the whole spathe deciduous, marcescent.
F. Ovule affixed to intruded placentæ: lva. ovate.....20. *Aglaonema.*
FF. Ovule affixed near top of cell: lvs. broadly arrow-shaped.....21. *Nephthytis.*
EE. Fr. included by accrescent tube of spathe: blade of spathe marcescent, deciduous.....22. *Zantedeschia.*
EEE. Fr. included by spathe, blade of which is persistent.....23. *Homalomena.*
EEEE. Fr. girt by the top-shaped tube of spathe, which has a circumscissile, deciduous blade.....24. *Schismatoglottis.*
BB. Fls. hermaphrodite.
C. Plants marsh herbs.....25. *Calla.*
CC. Plants are scandent shrubs.
D. Ovulea 2 in a cell, affixed to base of septum.....26. *Monstera.*
DD. Ovules solitary, basal.....27. *Scindapsus.*
DDD. Ovules numerous.....28. *Rhaphidophora.*
DDDD. Ovules 3 or 4 in a cell.....29. *Stenospermatium.*
AA. Perianth of 4–8 distinct segms.; fls. all hermaphrodite.
B. Spadix flowering downward; spathe long, often twisted, long-persistent.....30. *Cyrtosperma.*
BB. Spadix flowering upward.
C. Spathe sheathing the very long peduuculiform stipe of the spadix, with blade incomplete or 0.
D. Ovary 1-celled; ovules solitary, semi-anatropous.....31. *Orontium.*
DD. Ovary 2-celled; ovules 1–2 in a cell, orthotropous.....32. *Lysichitum.*
DDD. Ovary 1–2-celled; ovule 1 in each cell, suspended.....33. *Symplocarpus.*
DDDD. Ovary imperfectly 1–2-celled; ovule solitary, affixed to interior angle of cell.....34. *Dracontium.*
CC. Spathe provided with scale-like appendages in the tube, long-persistent: ovules semi-anatropous or campylotropous.....35. *Spathyema.*
CCC. Spathe leafy, accrescent, persistent, quite flattened out: ovules anatropous.....36. *Spathiphyllum.*
CCCC. Spathe open, recurved or reflexed, accrescent, persistent: ovules various.....37. *Anthurium.*
CCCCC. Spathe accrescent, persistent or obsolete: ovules anatropous.....38. *Pothos.*
CCCCCC. Spathe obsolete or obscure: ovules orthotropous.....39. *Acorus.*

Additional Key to the Araceæ.

The Araceæ are likely to be so difficult for the gardener that an additional key, based on other contrasts, is here inserted for his convenience.

A. Plants free-swimming, aquatic..... *Pistia.*
AA. Plants not free-swimming aquatics, terrestrial or marsh plants.
B. Lvs. parallel-veined (see also Calla and Acorus).
C. Plant shrub-like or climbing: st. more or less aërial: stamens of staminate fl. separate.

D. Blade of spathe deciduous; spathe constricted in middle, leaving a long tube when blade falls..... *Schismato-*
DD. Blade of spathe persistent, at least until ripening of spadix. *[glottis.*
E. Seeds anatropous..... *Homalomena.*
EE. Seeds orthotropous..... *Philodendron.*
CC. Plant with st. upright, aërial: stamens united into a synandrium.
D. Pistillate fls. crowded, without staminodia; staminate fls. with only 2–3 separate stamens..... *Aglaonema.*
DD. Pistillate fls. with staminodia interspersed; staminate fls. with 3–4 united stamens..... *Dieffenbachia.*
CCC. Plant with st. subterranean.
D. Seeds orthotropous or nearly so: the connate staminodia of the pistillate fl. forming an involucre around the gynœcium..... *Peltandra.*
DD. Seeds anatropous: staminodia of pistillate fls. separate..... *Zantedeschia.*
BB. Lvs. netted-veined (i.e. veins of 2nd, 3rd, and 4th order netted).
C. Milk-tubes absent.
D. Raphides absent (raphides are acicular crystals found in bundles in the plant-cell).
E. Lvs. differentiated into petiole and blade: seeds anatropous.
F. Seeds without endosperm..... *Pothos.*
FF. Seeds with endosperm..... *Anthurium.*
EE. Lvs. without distinction into petiole and blade: seeds orthotropous..... *Acorus.*
DD. Raphides present in ground tissue of st. and lvs.
E. Fls. without perianth; spathe deciduous before ripening of spadix: plants mostly climbing.
F. Seeds with endosperm and axial embryo.
G. Foliage-lvs. many on each shoot..... *Stenosper-*
GG. Foliage-lvs. 1 on each shoot in addition to several bracts..... *[mation.* *Raphidophora.*
FF. Seeds without endosperm.
G. Ovary 2-celled..... *Monstera.*
GG. Ovary 1-celled..... *Scindapsus.*
EE. Fls. with perianth; spathe not deciduous: sub-shrubs..... *Spathiphyllum.*
CC. Milk-tubes present in fibro-vascular bundles.
D. The milk-tubes branched; veins of 2nd grade fusing into a collective vein between veins of 1st grade.
E. Seeds with endosperm: st. not climbing.
F. Ovary with basal placenta..... *Alocasia.*
FF. Ovary with parietal placentæ..... *Colocasia.*
FFF. Ovary with broad, nearly central placentæ.
G. Style small..... *Caladium.*
GG. Style disk-like, projecting beyond ovary..... *Xanthosoma.*
EE. Seeds without endosperm: st. climbing..... *Syngonium.*
DD. The milk-tubes simple, straight; veins not as above.
E. Perianth present; fls. bisexual.
F. Lvs. not arrow-shaped.
G. Ovary 2-celled; 2 ovules in each cell, suspended from middle of partition..... *Lysichitum.*
GG. Ovary 1-celled, 1-ovuled.
H. Ovule from apex of cell: spadix short, nearly globular..... *Symplocarpus.*
HH. Ovule basal: spadix cylindrical..... *Orontium.*
FF. Lvs. arrow-shaped.
G. Plants are shrubs with climbing or creeping sts.: petioles and sts. usually prickly or warty..... *Cyrtosperma.*
GG. Plants tuberous..... *Dracontium.*
EE. Perianth absent; fls. unisexual (bisexual in Calla).
F. Fls. bisexual: lvs. not arrow-shaped. *Calla.*
FF. Fls. unisexual: lvs. various.
G. Spadix with a sterile terminal appendage, or with sterile wings: sts. various.
H. Seeds without endosperm.... *Amorphophal-*
HH. Seeds with endosperm. *[lus.*
I. Appendage of spadix projecting much beyond the spathe, or included and free.
J. Spadix with rudimentary fls. between the fertile staminate and fertile pistillate fls., or staminate infl. bordering immediately on the pistillate infl.
K. Placenta parietal: lvs. arrow-shaped or lanceolate..... *Arum.*
KK. Placentæ apical and basal: lvs. pedately divided.
L. Fertile staminate infl. bordering immediately on the pistillate infl..... *Dracunculus.*
LL. Fertile staminate infl. separated from pistillate infl. by many rudimentary fls..... *Helicodiceros.*
KKK. Placenta basal.
L. Lvs. pedately divided: seeds 2 or more..... *Sauromatum.*
LL. Lvs. ovate, lanceolate or linear: seeds mostly 1.... *Biarum.*
JJ. Spadix without rudimentary fls., but a space between the staminate and pistillate fls., or unisexual.
K. Ovary with many ovules.
L. Staminate fls. of 1 stamen: lvs. ovate or arrow-shaped: spadix bisexual.... *Arisarum.*
LL. Staminate fls. of 2–5 stamens: lvs. 3- or many-parted: spadix unisexual... *Arisæma.*
KK. Ovary 1-ovuled: staminate and pistillate portions of apadix separated by a partition which reaches out from wall of spathe..... *Pinellia.*
II. Appendages of the spadix wing-like on the 2 sides, thus dividing the bilabiate spathe into 2 chambers, the anterior of which contains a staminate fl., the posterior a pistillate fl..... *Ambrosinia.*
GG. Spadix without such appendage or wings: sts. subterranean, creeping..... *Nephthytis.*

Other genera described are Callopsis, Cryptocoryne, Epipremnum, Gamogyne, Gymnostachys, Staurostigma, Typhonium and Typhonodorum.

204. ALISMACEÆ.

A. Carpels inserted in a whorl on a small receptacle..... 1. *Alisma.*
AA. Carpels densely crowded in many series on a large oblong or globose receptacle..... 2. *Sagittaria.*

205. BUTOMACEÆ.

A. Petals marcescent; stamens 9; carpels 6..... 1. *Butomus.*
AA. Petals deciduous; stamens numerous; carpels 15–20..... 2. *Limnoch-* *[aris*

206. NAIADACEÆ.

A. Fls. hermaphrodite, spicate; perianth 4-divided; stamens 2 or 4..... 1. *Potamogeton.*
AA. Fls. unisexual, axillary; perianth 0; stamens 1. 2. *Zannichellia*

207. APONOGETONACEÆ.

The only genus..... *Aponogeton.*

208. CYPERACEÆ.

A. Fls. strictly unisexual; female inclosed in a flask-shaped or bag-shaped scale or glume (perigynium) ..... 1. *Carex.*
AA. Fls. bisexual, rarely unisexual, not inclosed as above.
B. With several (2 to many) of the lower scales empty.
C. Spikelets few-fld. (usually 1-2-, rarely, 3-6-fld.) ..... 2. *Rhynchospora.*
CC. Spikelets many-fld.
D. St. leafy ..... 3. *Hypolytrum.*
DD. St. not leafy or only at base ..... 4. *Mapania.*
BB. With only 1 or 2 of the lower scales empty.
C. Scales 2-ranked.
D. Perianth 0 ..... 5. *Cyperus.*
DD. Perianth of 8 setæ ..... 6. *Dulichium.*
CC. Scales many-ranked, overlapping.
D. Perianth of 3–8, rarely 0, setæ.
E. Style persistent, thickened and bulb-like at base ..... 7. *Eleocharis.*
EE. Style not or hardly thickened at base. 8. *Scirpus.*
DD. Perianth of many setæ, very long-excrescent after anthesis, becoming wavy or cottony ..... 9. *Eriophorum.*

209. GRAMINEÆ.

I. Summary of the Tribes.

Subfamily I. PANICOIDEÆ.

Spikelets 1-, rarely 2-fld.; the terminal fl. perfect, the lower staminate or neuter; rachilla articulated below the glumes, the more or less dorsally compressed spikelets falling from the pedicels entire, singly, in groups, or together with joints of an articulate rachis.

A. Spikelets unisexual, the male and female spikelets in different infl. on the same plant or in different parts of the same infl.; awnless ..... 1. INDIAN CORN [TRIBE, OR [MAYDEÆ.
AA. Spikelets perfect, sometimes with male or neutral ones intermixed.
B. Lemma and palea hyaline, the glumes more or less indurated; spikelets in 2's or 3's on the usually articulate axis of a spike-like raceme, 1 sessile and perfect, usually awned, the other pediceled and perfect, staminate or rudimentary ..... 2. SORGHUM TRIBE, OR ANDROPOGONEÆ.
BB. Lemma and palea more or less indurated, firmer in texture than the glumes; spikelets all perfect; first glume sometimes obsolete ..... 3. MILLET TRIBE, OR [PANICEÆ.

Subfamily II. POACOIDEÆ.

Spikelets 1- to many-fld., the imperfect or rudimentary floret, if any, usually uppermost; rachilla usually articulated above the glumes which are persistent on the pedicel or rachis after the fall of the florets; when 2- to many-fld., a manifest internode of the rachilla separating the florets, and articulated below them; spikelets more or less laterally compressed.

A. Culms not woody and perennial.
B. Infl. paniculate, the spikelets pediceled, not sessile on opposite sides of a jointed flattened axis, forming spikes, nor sessile along one side of a slender continuous axis.
C. Spikelets 1-fld., the rachilla sometimes continued as a minute bristle behind the palea (or in Phalarideæ a pair of rudimentary or male florets below the perfect one).
D. Spikelets falling entire; glumes usually obsolete or nearly so ... 4. RICE TRIBE, OR [ORYZEÆ.
DD. Spikelets persistent; glumes present.
E. Floret with 2 minute scales (rudimentary lemmas) or 2 small male florets attached at the base and falling with it ..... 5. CANARY-GRASS [TRIBE, OR [PHALARIDEÆ.
EE. Floret with no scales attached below; glumes usually subequal; lemma awned or awnless ..... 6. RED-TOP TRIBE, OR [AGROSTIDEÆ.
CC. Spikelets 2- to many-fld.
D. Glumes longer than the first floret; spikelets 2- to several-fld.; 1 or more of the florets usually awned from the back or from between the teeth of a bifid apex ..... 7. OAT TRIBE, OR [AVENEÆ.
DD. Glumes shorter than the first floret; spikelets 2- to many-fld; awns when present terminal or nearly so ..... 8. FESCUE TRIBE, OR [FESTUCEÆ.
BB. Infl. spicate.
C. Spikelets sessile or subsessile in 1-sided spikes, 1- to few-fld.; spikes solitary, or digitately or racemosely arranged ..... 9. CHLORIS TRIBE, OR [CHLORIDEÆ.
CC. Spikelets sessile on opposite sides of a zigzag jointed channeled axis forming a spike; 1- to several-fld. ..... 10. BARLEY TRIBE, OR [HORDEÆ.
AA. Culms woody, tree-like: lf.-blades articulated with the sheaths ..... 11. BAMBOO TRIBE, OR [BAMBUSEÆ.

II. Key to the Tribes.

1. Indian Corn Tribe, or Maydeæ.

A. Male spikelets in a terminal panicle; female spikelets in spikes or ears in the axils of the lvs.
B. Female spikelets sunken in cavities of a jointed readily disarticulating axis ..... 1. *Euchlæna.*
BB. Female spikelets crowded in rows on a thickened continuous axis (the cob) ..... 2. *Zea.*
AA. Male and female spikelets in the same infl., the male at the end of the spikes.
B. Spikes digitate, the axis of the female portion bony indurated, disarticulating with spikelets attached ..... 3. *Tripsacum.*
BB. Spikes paniculate, the female spikelets inclosed in ovoid pearly or grayish bead-like bodies, the male portion protruding from a small orifice of the bead ..... 4. *Coix.*

2. Sorghum Tribe, or Andropogoneæ.

A. Spikelets all alike, perfect.
B. Axis of racemes continuous, the spikelets deciduous; panicle fan-shaped ..... 5. *Miscanthus.*
BB. Axis of racemes jointed, readily disarticulating with the spikelets attached.
C. The spikelets awnless ..... 6. *Saccharum.*
CC. The spikelets awned ..... 7. *Erianthus.*
AA. Spikelets not all alike, the sessile perfect, the pediceled male or neuter.
B. Lower 1 or 2 pairs of spikelets unlike the upper pairs; racemes in pairs from boat-shaped sheaths on the ultimate branches of an elongated infl. ..... 8. *Cymbopogon.*
BB. Lower pairs of spikelets like the upper.
C. Infl. consisting of 1 to many racemes, these digitate or racemose along a short axis ..... 9. *Andropogon.*
CC. Infl. compound, paniculate.
D. Racemes many-fld., linear, naked at base, numerous, arranged in whorls on an elongated axis ..... 10. *Vetiveria.*
DD. Racemes reduced to 2 or 3 spikelets, arranged in a compound panicle ..... 11. *Holcus.*

3. Millet Tribe, or Paniceæ.

A. Axis broad and corky, the spikelets sunken in its cavities ..... 12. *Stenotaphrum.*
AA. Axis not broad and corky, spikelets not sunken in its cavities.
B. Spikelets not subtended or surrounded by bristles.
C. Glumes and lemmas awnless, the apex of the palea inclosed in the enfolding lemma ..... 13. *Panicum.*
CC. Glumes or lemmas, or both, awned or awn-tipped.
D. Second glume and sterile lemma tapering into an awn or point, coarsely hispid; palea free at the summit; spikelets crowded ..... 14. *Echinochloa.*
DD. Second glume and sterile lemma awned from a 2-lobed apex.
E. Infl. of 1-sided racemes along a common axis; spikelets pubescent but not silky; palea inclosed at summit. 15. *Oplismenus.*
EE. Infl. paniculate; spikelets covered with long silky hairs ..... 16. *Tricholæna.*
BB. Spikelets subtended or surrounded by bristles.
C. Bristles persistent, not falling with the spikelets at maturity ..... 17. *Setaria.*
CC. Bristles falling attached to the spikelet ... 18. *Pennisetum.*

4. Rice Tribe, or Oryzeæ.

A. Spikelets unisexual, the female awned, erect at the summit of the panicle, the male awnless, nodding on the lower branches ..... 19. *Zizania.*
AA. Spikelets perfect, strongly flattened ..... 20. *Oryza.*

5. Canary-Grass Tribe, or Phalarideæ.

A. Glumes strongly compressed; sterile lemmas rudimentary....21. *Phalaris.*
AA. Glumes not strongly compressed; sterile lemmas not rudimentary.
B. Sterile lemmas awned; glumes very unequal.22. *Anthoxanthum.*
BB. Sterile lemmas awnless; glumes nearly equal.23. *Hierochloë.*

6. Red-Top Tribe, or Agrostideæ.

A. Lemma indurated, or at least firmer than the glumes.
B. Panicle spike-like; spikelets flattened, awnless....24. *Ammophila.*
BB. Panicle not spike-like; spikelets not flattened, awned.
C. Floret oblong and with a sharp callus at base; awn stout, geniculate, twisted, persistent....25. *Stipa.*
CC. Floret ovate, the callus blunt; awn slender, more or less deciduous....26. *Oryzopsis.*
AA. Lemma of about the same texture as the glumes or more delicate.
B. Spikelets crowded in dense spike-like panicles or heads.
C. Heads oval, very woolly....27. *Lagurus.*
CC. Heads cylindrical, not woolly....28. *Phleum.*
BB. Spikelets not crowded in dense heads or spikes.
C. Lemma and palea much more delicate and shorter than the glumes, the palea shorter than the lemma, often wanting..29. *Agrostis.*
CC. Lemma and palea of about the same texture as the glumes and as long or longer.
D. Rachilla not continued beyond the base of the floret; lemma awned from the tip or awnless.
E. The lemma awned or sharp-pointed, longer than the body of the awned or awnless glumes....30. *Muehlenbergia.*
EE. The lemma not awned or sharp-pointed.
F. Nerves of lemma 1....31. *Sporobolus.*
FF. Nerves of lemma 3–5....32. *Calamovilfa.*
DD. Rachilla prolonged beyond the floret as a plumose bristle; lemmas awned on the back and silky hairy at base....33. *Calamagrostis.*

7. Oat Tribe, or Aveneæ.

A. Plants low, delicate; spikelets minute....34. *Aira.*
AA. Plants 1 ft. or more high.
B. Articulation below the glumes, the spikelets falling entire from the pedicels.
C. Glumes much exceeding the 2 florets, the upper floret with a hook-like awn....35. *Notholcus.*
CC. Glumes exceeded by the upper floret, both florets awnless....36. *Sphenopholis.*
BB. Articulation above the glumes, these persistent after the fall of the florets.
C. Spikelets 1 in. or more long, nodding, in an open panicle; florets all alike....37. *Avena.*
CC. Spikelets about ½in. long, erect in a narrow panicle; lower floret staminate....38. *Arrhenatherum.*

8. Fescue Tribe, or Festuceæ.

A. Rachilla or lemma bearing long hairs as long as the lemma: tall reeds.
B. Spikelets unisexual; male and female spikelets on separate plants.
C. Lemmas much shorter than the glumes: sts. leafy throughout....39. *Gynerium.*
CC. Lemmas with elongated delicate tips: lvs. crowded at the base....40. *Cortaderia.*
BB. Spikelets perfect.
C. Lemmas hairy; rachilla naked....41. *Arundo.*
CC. Lemmas naked; rachilla hairy....42. *Phragmites.*
AA. Rachilla or lemma glabrous or hairy, but the hairs shorter than the lemmas.
B. Spikelets of 2 kinds, perfect and sterile, in the same panicle.
C. Fertile spikelets awnless, the sterile awned; panicle spike-like....43. *Cynosurus.*
CC. Fertile spikelets awned, the sterile awnless; panicle 1-sided, the fascicled spikelets nodding....44. *Lamarckia.*
BB. Spikelets all alike in the same infl.
C. Lemmas 1–3-nerved.
D. The spikelets subterete, loosely 2–4-fld....45. *Molinia.*
DD. The spikelets compressed, densely, usually many-fld.
E. Florets membranaceous; spikelets in open panicles....46. *Eragrostis.*
EE. Florets coriaceous; spikelets in rigid spike-like panicles....47. *Desmazeria.*
CC. Lemmas 5- to many-nerved.
D. The spikelets with several sterile lemmas at the base, strongly flattened, in a large drooping panicle....48. *Uniola.*
DD. The spikelets without sterile lemmas at the base.
E. Florets crowded, nearly horizontal; spikelets broad, cordate....49. *Briza.*
EE. Florets not crowded; spikelets not broad and cordate.
F. Spikelets flattened, nearly sessile in dense clusters at the ends of the few panicle branches....50. *Dactylis.*
FF. Spikelets not flattened.
G. Lemmas keeled, often bearing white cobwebby hairs at base....51. *Poa.*
GG. Lemmas convex or keeled at the summit only, not hairy at base.
H. Nerves of lemma prominent, parallel; lemmas scarious at the summit....52. *Glyceria.*
HH. Nerves of lemma not prominent, approaching each other at the apex; lemmas acute.
I. The lemmas entire, often awn-tipped....53. *Festuca.*
II. The lemmas 2-toothed, usually awned just below the apex....54. *Bromus.*

9. Chloris Tribe, or Chlorideæ.

A. Spikes racemose along a common axis; spikelets falling entire....55. *Spartina.*
AA. Spikes digitate at the summit of the culm.
B. Spikelets awnless.
C. The spikes slender; spikelets 1-fld....56. *Cynodon.*
CC. The spikes stout; spikelets several-fld....57. *Eleusine.*
BB. Spikelets awned.
C. Fertile lemma 1-awned....58. *Chloris.*
CC. Fertile lemma 3-awned....59. *Trichloris.*

10. Barley Tribe, or Hordeæ.

A. Spikelets solitary at each joint of the axis.
B. Glume 1, except in terminal spikelet; spikelets placed with 1 edge to the axis....60. *Lolium.*
BB. Glumes 2; spikelets placed with side to the axis.
C. Palea adherent to the grain; rachilla disarticulating, the florets separating....61. *Agropyron.*
CC. Palea free from the grain; rachilla not disarticulating.
D. Shape of glumes very narrow, 1-nerved.62. *Secale.*
DD. Shape of glumes ovate, 3- to many-nerved....63. *Triticum.*
AA. Spikelets in clusters of 2 or 3 at each joint of the axis.
B. Lateral pair of each cluster pediceled, usually aborted, appearing like a cluster of awns....64. *Hordeum.*
BB. Lateral spikelets sessile, usually but 2 spikelets at a joint....65. *Elymus.*

11. Bamboo Tribe, or Bambuseæ.

A. Stamens 3: fr. a true caryopsis.
B. Spikelets 2- to many-fld.
C. Infl. fasciculate....66. *Oxytenanthera.*
CC. Infl. racemose or paniculate, not leafy: sts. cylindrical: sheaths persistent....67. *Arundinaria.*
CCC. Infl. spicate, leafy: sts. flattened on one side: sheaths early deciduous....68. *Phyllostachys.*
BB. Spikelets 1-fld....69. *Chusquea.*
AA. Stamens 6.
B. Pericarp thin, adnate to the seed, the fr. a true caryopsis....70. *Bambusa.*
BB. Pericarp, crustaceous, separable from the seed, the fr. nut-like....71. *Dendrocalamus.*

Other genera mentioned are: Cenchrus, Cephalostachyum, Cinna, Dactyloctenium, Deschampsea, Diandrolyra, Diatichlis, Imperata, Leptochloa, Melica, Melinis, Paspalum, Rottboellia and Trisetum.

210. LYCOPODIACEÆ.

One genus in cultivation....*Lycopodium.*

211. SELAGINELLACEÆ.

One genus only....*Selaginella.*

212. EQUISETACEÆ.

One genus only ..... *Equisetum.*

213. OPHIOGLOSSACEÆ.

A. Sporangia coherent, in 2 ranks, forming spikes: veins anastomosing ..... 1. *Ophioglossum.*
AA. Sporangia free in compound spikes or panicles: veins free: lvs. mostly compound ..... 2. *Botrychium.*

214. MARATTIACEÆ.

A. Sori in double lines along the veins, not united ..... 1. *Angiopteris.*
AA. Sori united in synangia.
B. Synangia oval, opening by a fissure ..... 2. *Marattia.*
BB. Synangia elongate, each compartment opening by a terminal pore ..... 3. *Danæa.*

215. HYMENOPHYLLACEÆ.

A. Involucre 2-valved ..... 1. *Hymenophyllum.*
AA. Involucre tubular or funnel-shaped ..... 2. *Trichomanes.*

216. OSMUNDACEÆ.

A. Sporangia borne in panicles formed either from certain pinnæ or from whole lvs ..... 1. *Osmunda.*
AA. Sporangia borne on the under surface of foliage lvs.
B. Ferns coarse with broad segms ..... 2. *Todea.*
BB. Ferns finely cut, membranous ..... 3. *Leptopteris.*

217. SCHIZÆACEÆ.

A. Sporangia borne on under side of normal or altered lva.
B. Lvs. twining; lfts. palmate or pinnate: sporangia borna singly under acale ..... 1. *Lygodium.*
BB. Lvs. not twining.
C. Sporangia in sori on the under surface ..... 2. *Mohria.*
CC. Sporangia in 2 ranks forming spikes ..... 3. *Schizæa.*
AA. Sporangia borne in erect panicles formed on the elongate lowermost pinnæ ..... 4. *Anemia.*

218. POLYPODIACEÆ.

I. Summary of Tribes.

A. Indusium wanting or rudimentary (rarely developed in Monogramma).
B. Sporangium scattered in a stratum over the under surface of the lva.: coarse ferns ..... 1. ACROSTICHUM TRIBE.
BB. Sporangium collected in round or linear sori.
C. Lvs. not jointed to the rootstock: sporangia in long lines following the veins ..... 2. VITTARIA TRIBE.
CC. Lvs. not jointed to the rootstock: sori round. (See Phegopteris in Dryopteris Tribe.)
CCC. Lvs. jointed to the rootstock: sori mostly roundish ..... 3. POLYPODIUM TRIBE.
AA. Indusium present (exceptionally wanting in Phegopteris, Meniacium, Notholæna and Ceropteris).
B. Sori oblong or linear, at least twice as long as broad.
C. The sori marginal, covered with an indusium formed of the reflexed edge of the lf. (naked in Notholæna, or naked and distributed along the veins in Ceropteris) .... 4. PTERIS TRIBE.
CC. The sori dorsal, covered with a flap-like indusium ..... 5. ASPLENIUM TRIBE.
BB. Sori roundish or at least less than twice as long as broad.
C. Indusia superior, attached by a central stalk or by a sinus (sori naked in Phegopteris and Meniacium), normally dorsal: lvs. not jointed to the rootstock ..... 6. DRYOPTERIS TRIBE.
CC. Indusia extrorse or cup-shaped, normally marginal: lva. jointed to the rootstock in most genera .. 7. DAVALLIA TRIBE.
CCC. Indusia inferior, attached under the sorus and opening laterally or by splitting radially into lobes. 8. WOODSIA TRIBE.

II. Key to the Tribes.

I. Acrostichum Tribe.

A. Sporangia localized on definite areas of the lva.: lvs. dimorphous, the sterile basal ones shield-like ..... 1. *Platycerium.*
AA. Sporangia covering entire lvs. or entire pinnæ.
B. Lvs. simple ..... 2. *Elaphoglossum.*
BB. Lvs. pinnate ..... 3. *Acrostichum.*
BBB. Lvs. (sterile), dichotomously forked ..... 4. *Rhipidopteris.*

2. Vittaria Tribe.

A. Sori forming 1 or 2 continuous lines parallel to the midrib.
B. Sorus 1 or 2 lines ..... 5. *Monogramma.*
BB. Sorus always 2 lines ..... 6. *Vittaria.*
AA. Sori on lateral veins forming more or less interrupted lines ..... 7. *Antrophyum.*

3. Polypodium Tribe.

A. Lvs. distinctly dimorphous, compound, the sterile basal ones oak-like: plants large ..... 8. *Drynaria.*
AA. Lvs. dimorphous, simple: plants very small ..... 9. *Drymoglossum.*
AAA. Lvs. uniform.
B. Foliage covered underneath with stellate hairs ..... 10. *Cyclophorus.*
BB. Foliage smooth or scaly, not stellate hairy.
C. Veins free ..... 11. *Polypodium.*
CC. Veins anastomosing.
D. Corresponding veinlets from principal veins uniting and bearing a sorus at the end ..... 12. *Goniophlebium.*
DD. Areole bearing 2 or more free veinlets extending outward, which bear a free sorus ..... 13. *Phlebodium.*
DDD. Areolea containing free veinlets irregularly directed ..... 14. *Phymatodes.*

4. Pteris Tribe.

A. Sori dorsal, extending along all the veins, naked.
B. Veins copiously anastomosing.
C. Lvs. large, pinnate ..... 15. *Coniogramma.*
CC. Lva. smaller, palmate ..... 16. *Hemionitis.*
BB. Veins free or only casually uniting.
C. Lvs. naked ..... 17. *Anogramma.*
CC. Lva. hairy ..... 18. *Ceropteris.*
AA. Sori marginal, nominally covered with edge of lf.
B. The sori at the ends of veins unconnected at their apices.
C. Lvs. dimorphous.
D. Sori at the ends of veins only ..... 19. *Cryptogramma.*
DD. Sori scattered the length of the veins ... 20. *Onychium.*
CC. Lvs. uniform, smooth, on dark-colored stalks.
D. Veins free: lvs. pinnate ..... 21. *Pellæa.*
DD. Veins usually anastomosing: lvs. palmate ..... 22. *Doryopteris.*
CCC. Lva. uniform, hairy, scaly or powdery.
D. Margins scarcely recurved ..... 23. *Notholæna.*
DD. Margins recurved to form a distinct indusium.
E. Indusia more or less continuous around the segm.
F. The lvs. pinnately divided ..... 24. *Cheilanthes.*
FF. The lvs. palmately divided ..... 25. *Adiantopsis.*
EE. Indusia in the form of more or less distant marginal lobes ..... 26. *Hypolepis.*
BB. The sori inserted beneath the marginal indusium; stalks black or blackish ..... 27. *Adiantum.*
BBB. The sori rising in a continuous line-like receptacle which joins the ends of the veins.
C. With an inner membranous indusium .... 28. *Pteridium.*
CC. With no inner indusium present.
D. Lvs. small, radiate-dichotomous ..... 29. *Actinopteris.*
DD. Lvs. small, palmate: stalk black ..... 30. *Cassebeera.*
DDD. Lvs. larger, pinnate ..... 31. *Pieris.*

5. Asplenium Tribe.

A. Sori parallel to the midrib.
B. Sterile lvs. with free veins: sori continuous .. 32. *Blechnum.*

BB. Sterile lvs. with anastomosing veins: sori interrupted.
C. The sori sunken in the lvs. ..... 33. *Woodwardia.*
CC. The sori superficial in 1 or more rows ..... 34. *Doodia.*
AA. Sori partly parallel and partly oblique to the midrib: veins anastomosing ..... 35. *Camptosorus.*
AAA. Sori oblique to the midrib.
B. Veins free, united at the margins.
C. The sori double, extending along both sides of the vein ..... 36. *Diplazium.*
CC. The sori single on the veins.
D. Indusia opening toward each other, in pairs ..... 37. *Phyllitis.*
DD. Indusia all opening toward the end of pinnæ or segms. ..... 38. *Asplenium.*
BB. Veins of lower (inner) series uniting: indusium extending both sides of veins ..... 39. *Callipteris.*

6. Dryopteris Tribe.

A. Indusium present.
B. Veins free, or with a single row of areoles along the mid-veins.
C. Indusia on the ends of veins which project beyond the margin of the lf. ..... 40. *Deparia.*
CC. Indusia dorsal.
D. The indusium cordate or reniform, attached by the sinus, sometimes wanting ..... 41. *Dryopteris.*
DD. The indusium orbicular, peltate, attached by a central stalk ..... 42. *Polystichum.*
DDD. The indusium oval, fixed to a central elongate receptacle ..... 43. *Didymochlæna.*
BB. Veins anastomosing.
C. The indusium cordate or reniform, attached by the sinus ..... 44. *Tectaria.*
CC. The indusium peltate, attached by a central stalk: veins forming small areoles ..... 45. *Cyrtomium.*
AA. Indusium wanting.
B. Veins free ..... 46. *Phegopteris.*
BB. Veins anastomosing.
C. The main veins joined by arches which bear the curved sori ..... 47. *Gymnopteris.*
CC. The sori round, attached dorsally.
D. Sori distinct at maturity ..... 48. *Meniscium.*
DD. Sori confluent at maturity ..... 49. *Leptochilus.*

7. Davallia Tribe.

A. Indusium attached at base only.
B. Pinnæ jointed to the rachis; lvs. simply pinnate: indusium circular or reniform ... 50. *Nephrolepis.*
BB. Pinnæ not jointed to the rachis; lvs. jointed to the rootstock
C. The indusium thick, coriaceous ..... 51. *Humata.*
CC. The indusium membranous ..... 52. *Leucostegia.*
AA. Indusium attached at both base and sides.
B. Lvs. jointed to the scaly rootstocks.
C. Shape of indusium tubular ..... 53. *Davallia.*
CC. Shape of indusium broader than long, forming a boat-shaped cavity on the edge of the segm. ..... 54. *Loxoscaphe.*
BB. Lvs. not jointed to the rootstocks.
C. Indusia near the end of unmodified lf.-lobes.
D. Sorus formed on receptacles containing vascular tissues ..... 55. *Microlepia.*
DD. Sorus not formed on a special receptacle. 56. *Odontosoria.*
CC. Indusium united with the modified lf.-lobe to form a complete cup ..... 57. *Dennstædtia.*

8. Woodsia Tribe.

A. Lvs. uniform, plane; veins free.
B. Indusium beneath the sorus, breaking up into linear lobes ..... 58. *Woodsia.*
BB. Indusium extrorse, opening laterally with a hood-like lobe ..... 59. *Cystopteris.*
AA. Lvs. dimorphous, the sporophylls closely rolled together.
B. Veins free: lvs. in crowns ..... 60. *Matteuccia.*
BB. Veins anastomosing: lvs. scattered ..... 61. *Onoclea.*

Brainea, Compteris, and Lonchitis are briefly described.

219. GLEICHENIACEÆ.

Single genus in cultivation ..... *Gleichenia.*

220. CYATHEACEÆ.

A. Sori borne on the apex of the veins: indusium extrorse, formed of a more or less modified marginal tooth and an inner lid-like scale ..... 1. DICKSONIA TRIBE.
AA. Sori borne dorsally on the veins or at the fork: indusium inferior, or wholly wanting ..... 2. CYATHEA TRIBE.

1. Dicksonia Tribe.

A. Tooth of spore-bearing segm. scarcely modified, about the size of the inner scale ..... 1. *Dicksonia.*
AA. Tooth of the spore-bearing segm. strongly modified, coriaceous like the inner scale and usually larger ..... 2. *Cibotium.*

2. Cyathea Tribe.

A. Indusium present, inferior.
B. The indusium at first inclosing the globular sorus, remaining cup-shaped or irregularly splitting at maturity ..... 3. *Cyathea.*
BB. The indusium membranous, semi-circular, more fully inclosing the sorus ..... 4. *Hemitelia.*
AA. Indusium wanting ..... 5. *Alsophila.*

Thyrsopteris, of another tribe, may be expected in cultivation and is briefly accounted for in this work.

221. CERATOPTERIDACEÆ.

Habit aquatic: single genus ..... *Ceratopteris.*

222. SALVINIACEÆ.

A. Lvs. minute, numerous, closely imbricated: sporocarps of 2 kinds, the larger globose, the smaller ovoid ..... 1. *Azolla.*
AA. Lvs. larger, fewer, distinct: sporocarps uniform, globose ..... 2. *Salvinia.*

223. MARSILEACEÆ.

In cultivation ..... *Marsilea.*

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NOTE

The foregoing index comprises only the names in the Key, not all those in the Cyclopedia. It is not intended that the Key shall include every small or incidental generic entry or paragraph in the volumes, for that would make it more involved and complicated. (See page 79.) At the end of some of the families the names of other genera are sometimes given, so far as these small entries were positively determined when the Key was made, for the purpose of aiding the student to a completer knowledge of the family or of advising him of entries that he might overlook. In the progress of the work, other minor or outlying or very recently introduced genera will undoubtedly be inserted, and such new definitions of genera may be made as will necessitate some shifting of names. All such additional entries will be accounted for, under their proper families, in the General Index at the close of Vol. VI.

NAME-LIST

ENGLISH EQUIVALENTS OF LATIN NAMES OF SPECIES

The technical or botanical name of a plant is a combination of two words,—the generic word, common to the entire group or genus; the specific or particular word, designating the given species: as *Briza maxima,* the large briza, *B. minor,* the small briza, and *B. media,* the intermediate briza. The second or species-word usually is an adjective descriptive of some feature of the plant, although it is sometimes geographical, as *Abies sibirica,* the Siberian abies, or commemorative, as *A. Fraseri,* Fraser's abies. Although the species-word is not always designative and is sometimes even inapplicable, nevertheless the student is aided if he knows what the word means in English translation; and the following list is inserted to supply this knowledge for characteristic Latin or Latinized descriptive adjectives (in some cases nouns in the genitive or in apposition) applied to the species of plants. These words are likely to be used in differing meanings in different genera and as applied by different authors; in many cases, they do not follow the usages of classical Latin: therefore a list of this kind cannot be exact or give all the meanings in which the words may be applied as specific names. The generic names (the first word in the combination) need not be listed here, for they are not adjectives of description but made-up substantives; and, moreover, their origins are explained at the entries in the text.

The species-adjective is made to agree with its genus in gender: thus the Latin adjective *aureus* (golden) takes the regular masculine termination in *Calochortus aureus,* because Calochortus is masculine; the feminine termination in *Albuca aurea;* the neuter in *Acrostichum aureum;* in Sorbus it is feminine (*S. aurea*) even though the generic name is masculine in form, because most trees are feminine whatever the termination of the name. In the following list, for convenience most of the adjectives are printed in the masculine form. The leading exceptions are those that terminate in *-fer* and *-ger,* meaning "bearing," these being given in the feminine form.

The above examples illustrate prevailing terminations of species-words. Other adjectives have other forms, as *niger, nigra, nigrum* (black); *asper, aspera, asperum* (rough); *acaulis, acaule* (stemless); the termination *-ensis* (belonging to, citizen of), as in *canadensis, canadense* (not *-um*). Commemorative personal species-names may be in the genitive or in the form of an adjective; as *Stanhopea Lindleyi,* Lindley's stanhopea; *Selenipedium Lindleyanum,* Lindleyan selenipedium. If the person's name ends in a hard consonant, the termination (under the recent Vienna code) is in double ii, as *Canna Lambertii.* If for a woman, the termination is feminine, as *Acacia Wayæ.* Substantive names in apposition hold their own termination, and the word in such cases should begin with a capital letter, if it is a proper name or an old generic name, as *Hibiscus Sabdariffa, Artemisia Absinthium, Begonia Rex.* Such words are usually old generic names or prominent vernacular substantives, and they commonly record some historical connection of the plant.

In all the regular entries in the Cyclopedia the pronunciation is indicated (see explanation p. xii); but it is also indicated again in the following lists: when the emphatic syllable is indicated as ending in a vowel and with a grave accent, the vowel is pronounced long, as *acutifò lius, pù milus;* when it ends in a consonant and is marked with an acute accent, the vowel is short, as *máx imus, arvén sis.* There are differences of practice in the pronouncing of many of the names in this list, but the list represents the method in this Cyclopedia; and if it should so happen that there are any inconsistencies between the list and the text, it is desired that the list shall hold.

Very many names are compounded from generic or subgeneric names, representing similarity or likeness to. These the reader will be able to recognize at once, and they need not be entered in this list. Examples are: *achilleæfolius,* achillea-leaved; *achilleoides,* achillea-like; *acrostichoides,* acrostichum-like; *bellidiflorus,* bellis-flowered; *lamiifolius,* lamium-leaved; *xiphioides,* xiphium-like; *tremuliformis,* tremula-formed or -shaped; *cacaliopsis,* cacalia-like; *atriplicis,* atriplex-like; *scillaris,* scilla-like.

The glossary, beginning page 160, will be helpful in giving other botanical equivalents and in accounting for other words that are sometimes applied as species-names.

abbreviâ tus: abbreviated, shortened.
abortî vus: aborted, parts failing.
abrúp tus: abrupt, suddenly changing in shape or character.
abyssín icus: Abyssinian.
acaû lis: stemless.
acéph alus: headless.
acér bus: acerb, harsh or sour (taste).
aceroî des: acer-like, maple-like.
acerô sus: needle-shaped.
aciculâ ris: needle-like.
acidís simus: exceedingly sour.
âc idus: acid, sour.
acinâ ceus: scimetar- or saber-shaped.
â cris: acrid, sharp.
aculeâ tus: prickly.
acuminâ tus: acuminate, long-pointed, tapering.
acutân gulus: acutely or sharply angled.
acutíf idus: acutely or sharply cut.
acutifô lius: acutely leaved, sharp-leaved.
acutîl obus: acutely lobed.
acutipét alus: petals acute or sharp (pointed).
acû tus: acute, sharp-pointed.
admirâb ilis: admirable, noteworthy.
adnâ tus: adnate, joined to.
adprês sus: pressed against.
adscén dens: ascending.
adsúr gens: rising to an erect position, ascending.
adún cus: hooked.
âd venus: newly arrived, adventive.
ægyptî acus: Egyptian.
æm ulus: emulative, imitating.
aê neus: brazen, bronze-colored.
æquinoctiâ lis: pertaining to the equinox.
æquipét alus: equal-petaled.
æruginô sus: rusty, rust-colored.
æstivâ lis: summer.
æstî vus: summer.
æthiôp icus: Ethiopian, African.
affî nis: related (to another species).
africâ nus: African.
agavoî des: Agave-like.
ageratoî des: ageratum-like.
aggregâ tus: aggregate, clustered.
agrâ rius: of the fields.
agrês tis: of or pertaining to the fields.
aizoî des: aizòon-like (Aizò on, an evergreen or tenacious plant).
alâ tus: winged.
albés cens: whitish, becoming whits.
âl bicans: whitish.
albicaû lis: white-stemmed.
âl bidus: white.
alhiflô rus: white-flowered.
âl bifrons: white-fronded, white-herbaged.
alhispî nus: white-spined.
albocínc tus: white-girdled, white-crowned.
alhospî cus: white-spiked.
âl bus: white.
alcicôr nis: elk-horned.

alép picus: of Aleppo (in Syria).
allià ceus: of the alliums, garlic-like.
aloî des: aloe-like.
alpés tris: alpine.
alpì nus: alpine.
altà icus: of the Altai Mts. (S. Siberia).
altér nans: alternating.
altér nus: alternating, alternate.
ál tifrons: tall-fronded or -herbaged.
altís simus: very tall, tallest.
ál tus: tall.
amáb ilis: lovely.
amà rus: bitter.
ambíg uus: ambiguous, doubtful.
amelloî des: amellus-like.
americà nus: American.
amethýs tinus: amethystine, violet-colored.
amœ̀ nus: charming, pleasing.
amphíb ius: amphibious, growing both in water and on land.
amplexicaù lis: stem-clasping.
amplís simus: most or very ample.
ám plus: ample, large, extended.
amurén sis: of the Amur River region (E. Siberia).
amygdál inus: pertaining to or like amygdalus.
anacán thus: without spines.
anatôl icus: of Anatolia (Asia Minor).
án ceps: two-headed, two-edged.
andíc olus: native of the Andes.
andì nus: Andine, Andian, pertaining to the Andes.
andrôg ynus: with both staminate and pistillate flowers in one cluster.
anfractuô sus: twisted.
án glicus: English, pertaining to England.
anguì nus: snaky, pertaining to serpents.
angulà ris: angular, angled.
angulà tus: angular, angled.
angulò sus: angular, angled.
angús tus: narrow.
annôt inus: year-old.
annulà ris: annular, ringed.
annulà tus: annular.
án nuus: annual, living but one year.
anóm alus: anomalous, out of the ordinary or usual.
antillà ris: of the Antilles (W. Indies).
antíp odum: of the antipodes.
antiquò rum: of the ancients.
antì quus: ancient.
apennì nus: pertaining to the Apennines (Italy).
apér tus: uncovered, bare.
apét alus: without petals.
aphýl lus: leafless.
apiculà tus: apiculate, tipped with a point.
appendiculà tus: appendaged, bearing an extension or additional part or process.
applanà tus: flattened.
applicà tus: joined, attached.
áp terus: wingless.
aquát icus, aquát ilis: aquatic.
à queus: aqueous, watery.
aquilì nus: aquiline, pertaining to the eagle.
aráb icus: Arabian.
arachnoî des: spider-like, cobwebby.
arborés cens: becoming tree-like, woody.
arbò reus: tree-like.
árc ticus: arctic.
arcuà tus: bow-like, bowed.
arenà rius: of sand or sandy places.
areolà tus: areolate, pitted.
argentà tus: silvery, silvered.
argén teus: silvery.
argophýl lus: silver-leaved.
argù tus: sharp-toothed.
argyrœ̀ us: silvery.
ár idus: arid.
arietî nus: like a ram's head.
aristà tus: aristate, bearded.
aristò sus: bearded.
armà tus: armed (as with thorns).
aromát icus: aromatic.
arréct us: raised up, erect.
articulà tus: articulated, jointed.
arundinà ceus: reed-like.
arvén sis: pertaining to cultivated fields.
ascén dens: ascending.
asiát icus: Asian.
ás per: rough.
asperà tus: rough.
aspericaù lis: rough-stemmed.
aspér rimus: very rough.
assím ilis: similar, like to.
assúr gens: assurgent, clambering.
à ter: coal-black.
atlánt icus: Atlantic, growing in Atlantic regions.
atrà tus: blackened.
atropurpù reus: dark purple.
atrôr ubens: dark red.
atrosanguín eus: dark blood-red.
atrôv irens: dark green.
attenuà tus: attenuated, produced to a point.
át ticus: pertaining to Attica or Athens, Greek.
augustís simus: very notable.
augúst us: august, notable, majestic.
aurantì acus: orange-red.
aurè olus: golden.
aù reus: golden.
auriculà tus: auricled, eared.
australién sis: belonging to Australia.
austrà lis: southern.
austrì acus: Austrian.
autumnà lis: autumnal.
axillà ris: axillary, borne in the axils, pertaining to the axils.
azù reus: azure, sky-blue.

baccà tus: berried.
baccíf era: berry-bearing.
baleár icus: Balearian, of the Balearic Islands.
balsà meus: balsamie, balsam-like, with balsam odor.
balsamíf era: balsam-bearing.
bambusoî des: bambusa-like, bamboo-like.
banát icus: of Banat (S. Hungary).
barbadén sis: of Barbadoes.
bár barus: foreign, from a strange country.
barbà tus: barbed, bearded.
barbíg era: bearing barbs or beards.
basilà ris: pertaining to the base or bottom.
bél lus: handsome.
benedíc tus: blesséd.
benghalén sis: of Bengal (E. India).
betuloî des: Betula-like, birch-like.
bicarinà tus: twice-keeled, with two keels.
bíc olor: two-colored.
bicór nis: two-horned.
bicornù tus: two-horned.
bidentà tus: two-toothed.
bién nis: biennial, living only two years.
bíf idus: twice cut, in two parts.
biflò rus: two-flowered.
bifurcà tus: twice-forked.
bigíb bus: with two swellings or projections.
biglù mis: two-glumed.
bíj ugus: yoked two together, joined, fastened together.
bíl obus: two-lobed.
binà tus: twin, double, two-and-two.
binér vis: two-nerved.
binoculà ris: binocular, two-eyed, two-spotted.
bipartì tus: two-parted.
bipét alus: two-petaled.
bipinnatíf idus: bipinnatifid, twice pinnately cut.
bipinnà tus: bipinnate, twice pinnate.
bipunctà tus: two-spotted.
biséc tus: cut in two parts.
bispinò sus: two-spined.
biternà tus: twice ternate.
blán dus: bland, mild.
bô nus: good.
borbôn icus: of Bourbonne (in N. E. France).
boreà lis: northern.
botryoî des: cluster-like, grape-like.
brachià tus: brachiate, branched at right angles.
brachýp odus: short-stalked.
bracteà tus: bracteate, bearing braets.
bracteò sus: bract-bearing.
brevicaù lis: short-stemmed.
brév ifrons: short-fronded, short-leaved.
brév ipes: short-footed, as with short pedicel or petiole.
brevirós tris: short-beaked.
brè vis: short.
brevisè tus: short-bristled.
brevís pathus: short-spathed.
brevís simus: very short, shortest.
brilliantís simus: most brilliant, very brilliant.
brún neus: deep brown.
bucéph alus: ox-headed.
bufô nius: pertaining to the toad.
bulbíf era: bulb-bearing.
bulbô sus: bulbous.
bullà tus: inflated, swelling, puckered, bullate.
byzantì nus: Byzantine (of the Constantinople region).

cærulés cens: becoming or turning dark blue.
cærù leus: cerulean, dark blue.
cæ̀ sius: bluish gray.
cæspitò sus: cespitose, tufted, growing in low dense clumps.
cáf fer, caffra: Kafir.
caláb ricus: from Calabria (in S. Italy).
calathî nus: basket-like.
calcarà tus: spurred, with spurs.
calcà reus, of or pertaining to lime.
callò sus: thick-skinned, with callosities.

câl vus: bald, hairless.
calỹc inus: calyx-like.
calyculà tus: calyx-like, calyx-bearing, fruit inclosed in a calyx.
câm bricus: Cambrian, Welsh.
campanulà tus: campanulate, bell-shaped.
campés tris: of the fields or plains.
canadén sis: Canadian.
canaliculà tus: channeled, grooved.
canarién sis: of the Canary Isls.
cân dicans: white, hoary, particularly white-hairy or white-woolly.
candidís simus: very white-hairy or hoary.
cantáb ricus: from Cantabria (in Spain).
cân didus: white, white-hairy, shining.
canés cens: gray-pubescent.
cà nus: ash-colored, hoary.
capén sis: of the Cape (of Good Hope).
capillà ris: hair-like.
capreolà tus: winding, twining.
capsulà ris: capsular.
cardinà lis: cardinal.
carinà tus: keeled.
cár neus: flesh-colored.
carnô sus: fleshy.
carolinià nus: Carolinian, pertaining to North or South Carolina, or indefinitely to the Carolinas.
carpáth icus: of the Carpathian region (Europe).
cartilagín eus: like cartilage.
caryophyllà ceus: clove-like; perhaps also pertaining to the pink family.
cashmerià nus: of Cashmere (Asia).
cathár ticus: cathartic.
cathayà nus: of Cathay (China).
caucás icus: belonging to the Caucasus (mountain region between the Black and Caspian Seas).
caudà tus: caudate, tailed.
caulés cens: caulescent, having a stem or stems.
cauliflô rus: stem-flowered.
cenís ius: of Mt. Cenis (between France and Italy).
cephalà tus: headed, bearing heads.
cerasifór mis: cherry-formed.
cerefô lius: wax-leaved.
cerífera: wax-bearing.
cér nuus: bending forward, inclined, drooping, nodding.
ceylán icus: of Ceylon; same as *zeylanicus*.
chalcedôn icus: of Chalcedon (on the Bosphorus).
chilén sis: belonging to Chile.
chinén sis: belonging to China.
chlorán thus: green-flowered.
chrysân thus: golden-flowered.
chrysocár pus: golden-fruited.
chrysophýl lus: golden-leaved.
chrysôs tomus: golden-mouthed, golden-throated.
cilià ris: ciliate, fringed with hairs on the margin.
cilià tus: ciliate, hairy fringed.
cilíc icus: of Cilicia (in S. E. Asia Minor).
cínc tus: girded, girdled.
cinè reus: ash-colored.
cinnabarì nus: cinnabar-red.
cinnamô meus: cinnamon-brown.
circinà tus: circinate, coiled.
cirrhô sus: tendrilled.
citrà tus: citrus-like.
citrì nus: citron-colored or -like.
clandestì nus: concealed.
clavà tus: clavate, club-shaped.
clematíd eus: pertaining to or like clematis.
clypeà tus: with a shield.
coccíf era: berry-bearing.
coccín eus: scarlet.
cochleà ris: spoon-like.
cochleà tus: spoon-like.
cœlestì nus: sky-blue.
cœlés tis: celestial, sky-blue.
colll nus: pertaining to a hill.
colorà tus: colored (other than green).
comà tus: with coma or hair.
commù nis: common, general, gregarious.
commutà tus: changed or changing.
comô sus: with long hair.
compâc tus: compact, dense.
compléx us: circled, embraced.
complicà tus: complicate; page 162.
comprés sus: compressed.
cómp tus: adorned, ornamented.
côn cavus: concave, hollowed out.
concín nus: neat, well made.
côn color: colored similarly.
condén sus: condensed, crowded.
confér tus: crowded.
confôr mis: similar, like to.
confù sus: confused, uncertain (as to characteristics).
congés tus: congested, brought together.
conglomerà tus: conglomerate, crowded together.
conífera: cone-bearing.
conjugà tus: connected, joined together.
conoíd eus: conoid, cone-like.
consól idus: consolidated, solid, stable.
conspíc uus: conspicuous, marked.
constríc tus: constricted.
contíg uus: contiguous, near together.
contôr tus: contorted, twisted.
contrác tus: contracted.
coralliflô rus: coral-flowered.
corál linus: coral-red.
cordà tus: cordate, heart-shaped.
cordifô lius: cordate-leaved, heart-leaved.
corià ceus: leathery.
corniculà tus: horned.
cornígera: horn-bearing.
cornù tus: horned.
coronà rius: used for or belonging to garlands.
coronà tus: crowned.
corrugà tus: corrugated, wrinkled.
cór sicus: Corsican (island in the Mediterranean).
corticô sus: heavily furnished with bark.
corús cans: vibrating, glittering.
corymbíf era: corymb-bearing.
corymbô sus: corymbose.
costà tus: costate, ribbed.
crassicaû lis: thick-stemmed.
crassifô lius: thick-leaved.
crás sipes: thick-footed or -stalked.
crás sus: thick, fleshy.
crenà tus: crenate, scalloped.
crenulà tus: crenulate, somewhat scalloped.
crepidà tus: sandaled, slippered.
crép itans: rattling, rustling.
cretà ceus: cretaceous, pertaining to chalk.
crét icus: of Crete (island in Eastern Mediterranean).
crinì tus: hairy, provided with hair.
crís pus: crisped, curled.
cristà tus: cristate, crested.
crocà tus: saffron-yellow.
crô ceus: saffron-colored, yellow.
crucià tus: cruciate, cross-like.
crucíf era: cross-bearing.
cruén tus: bloody.
crystâl linus: crystalline.
cubén sis: Cuban.
cucullà tus: hooded.
cultrà tus: cultrate, knife-shaped.
cuneà tus: cuneate, wedge-shaped.
cuneifô lius: wedge-leaved.
cuneifôr mis: wedge-formed.
cù preus: copper-like or -colored.
curvà tus: curved.
cuspidà tus: cuspidate, with a cusp or sharp stiff point.
cyà neus: blue.
cylindrà ceus: cylindrical.
cylín dricus: cylindrical.
cymbifôr mis: boat-formed.
cymô sus: cymed, having a cyme or cymes.
cỳ preus: copper-like; see *cupreus*.

dactylíf era: finger-bearing.
dahù ricus, davù ricus: Of Dahuria or Dauria (in Trans-Baikal Siberia, near the frontier of China).
dalmát icus: Dalmatian (on eastern side of the Adriatic).
damascè nus: of Damascus.
dasycár pus: thick-fruited.
dealbà tus: whitened, white-washed.
déb ilis: weak, frail.
decán drus: ten-stamened.
decapét alus: ten-petaled.
decíd uus: deciduous, with parts falling.
decíp iens: deceptive.
declinà tus: declined, bent downward.
decolô rans: discoloring, staining.
decompôs itus: decompound, more than once compound or divided.
déc orans: adorning.
decô rus: elegant, comely, becoming.
decúm bens: decumbent, reclining at the base but the top or tips upright.
decúr rens: decurrent, as a leaf extending down the stem.
defléx us: deflexed, bent abruptly downward.
defôr mis: misshapen, deformed.
delèc tus: chosen.
delicatís simus: most or very delicate.
delicà tus: delicate, tender.
deliciô sus: delicious.
deltoíd eus: deltoid, triangular.
demís sus: low, weak.
dendroíd eus: tree-like.
densiflô rus: densely flowered.
dén sus: dense.
dentà tus: toothed.
denticulà tus: denticulate, slightly toothed.
dentô sus: toothed.
denudà tus: denuded, naked.

depauperà tus: depauperate, starved, dwarfed.
depén dens: hanging down.
deprês sus: depressed.
deús tus: burned.
devastà tor: (feminine *devastatrix*): devastating, laying waste.
discân thus: two-spined.
diadè ma: a diadem, crown.
dián drus: with two stamens.
diáph anus: diaphanous, very thin, transparent.
dichôt omus: forked, two-branched equally.
dích rous: of two colors.
dicóc cus: with two berries.
díd ymus: in a pair, as of anthers.
diffôr mis: of differing forms.
diffù sus: diffuse, spreading.
digità tus: digitate, compound in form like the fingers.
dilatà tus: dilated, expanded.
dilà tus: dilated, spread out.
dimidià tus: halved, in two equal parts.
dimór phus: dimorphous, two-formed.
dí odon: with two teeth.
dioí cus: dicœcious.
dipét alus: two-petaled.
diphýl lus: two-leaved.
dipsà ceus: of the teasel or Dipsacus.
discoíd eus: discoid, rayless.
dís coíor: of two or of different colors.
dís par: dissimilar, unlike.
disséc tus: dissected, deeply cut.
dissím ilis: dissimilar, unlike.
dissitiflô rus: remotely or loosely flowered.
distà chyus: two-spiked.
dís tans: distant, separate, remote.
dís tichus: two-ranked, with leaves or flowers in ranks on opposite sides of stem.
dís tylus: two-styled.
diúr nus: day-flowering.
divaricà tus: divaricate, spreading, widely divergent.
divér gens: diverging, wide-spreading.
diversiflô rus: diversely flowered, variable-flowered.
diversifô lius: variable-leaved.
divi sus: divided, separated.
dodecán drus: twelve-stamened.
doíabrifór mis: hatchet- or ax-shaped.
doiô sus: deceitful.
domês ticus: domestic, domesticated.
drupà ceus: drupe-like.
drupíf era: drupe-bearing.
dù bius: dubious, doubtful.
dúl cis: sweet.
dumetô rum: of bushes or hedges.
dumô sus: bushy.
dù plex: double.
duplicà tus: duplicate, double.
durâb ilis: durable, lasting.
durâc inus: hard-berried.
duriús culus: somewhat hard or rough.

ebenà ceus: ebony-like.
ebracteà tus: bractless.
ebúr neus: ivory-white.
echinà tus: bristly, prickly.
echinocâr pus: prickly-fruited.
echinosêp alus: prickly-sepaled.
ecornù tus: hornless.
edù lis: edible.
effù sus: very loose-spreading.
eiás ticus: elastic.
elà tior: taller.
elà tus: tall.
él egans: elegant.
elegantís simus: most elegant, very elegant.
elephán tum: of the elephants.
ellíp ticus: elliptical.
elongà tus: elongated, lengthened.
emarginà tus: emarginate, with a shallow notch at the apex.
emét icus: emetic.
ém inens: eminent, prominent.
enneaphýl lus: nine-leaved.
ensà tus: sword-shaped.
ensifô lius: sword-leaved.
ensifór mis: sword-formed or -shaped.
entomôph ilus: insect-loving.
equés tris: pertaining to the horse.
equí nus: of horses.
eréc tus: erect, upright.
eriân thus: woolly-flowered.
ericoí des: erica-like, heath-like.
eriocâr pus: woolly-fruited.
eriocéph alus: woolly-headed.
erô sus: erose, jagged, as if gnawed.
errât icus: erratic, unusual, sporadic.
erubés cens: blushing.
erythrocâr pus: red-fruited.
erythrocéph alus: red-headed.
erythrôp odus: red-footed, red-stalked.
erythrôp terus: red-winged.
esculén tus: esculent, edible.
estrià tus: without stripes.
etuberô sus: without tubers.
europè us: European.
exaltà tus: exalted, very tall.
excavà tus: excavated, hollowed out.
excél lens: excellent, excelling.
excél sus: tall.
excí sus: excised, cut away.
exíg uus: little, small, poor.
exím ius: distinguished, out of the ordinary.
exitiô sus: pernicious, destructive.
exoiè tus: mature, fully grown, dying away.
exôt icus: exotic, from another country.
expán sus: expanded.
exscúlp tus: dug out, carved out.
exsér tus: exserted, protruding from.
exsúr gens: rising up, standing up.
extén sus: extended.
exù dans: exuding.

fabà ceus: faba-like, bean-like.
falcà tus: falcate, sickle-shaped or scythe-shaped.
falcifô lius: falcate-leaved.
falcifór mis: sickle-formed.
fál lax: deceptive.
farinà ceus: containing farina or starch, or like flour; perhaps also farinose.
farinif era: farina-bearing.
farinô sus: farinose, mealy, powdery.
fascià tus: fasciate, abnormally flattened and broadened.
fasciculà ris: fascicled, clustered, brought together.
fascícuiâ tus: fascicled.
fascinà tor: fascinating, charming.
fastigià tus: fastigiate, branches erect and close together.
fastuô sus: proud.
febrif ugus: febrifuge, fever-dispelling.
fenestrà lis: with window-like openings.
fê rox: ferocious; very thorny.
fér reus: pertaining to iron.
ferrugín eus: rusty, of the color of iron rust.
fér tilis: fertile, fruitful.
festí vus: festive, gay, bright.
fibrô sus: fibrous, bearing prominent fibers.
ficoíd eus: fig-like.
filamentô sus: filamentous, composed of threads or bearing threads.
filicà tus: fern-like, ferny.
filicifô lius: fern-leaved.
filicí nus: fern-like.
filicol des: fern-like.
filíf era: bearing filaments or threads.
filifô lius: thread-leaved, with leaves cut into thread-like divisions.
filifór mis: filiform, thread-like.
fíl ipes: with stalks thread-like.
fimbrià tus: fimbriated, fringed.
firmà tus: firm, made firm.
fír mus: firm, strong.
fissifô lius: split-leaved.
fís silis: fissile, cleft or split.
fís sus: cleft, split.
fistulô sus: fistular, hollow-cylindrical.
flabellà tus: flabellate, with fan-like parts.
flabelliför mis: fan-formed.
flác cidus: flaccid, soft.
flagellà ris: flagellate, whip-like.
flagellà tus: whip-like.
flagelliför mis: whip-formed.
flagél lum: a scourge or flail.
flám meus: flame-colored.
flavés cens: yellowish, becoming yellow or yellowish.
flavíc omus: yellow-wooled or -haired.
fláv idus: yellow, yellowish.
flavispí nus: yellow-spined.
flá vus: yellow.
fléx ilis: flexible, pliant.
flexuô sus: flexuose, tortuous, zig-zag.
floccô sus: woolly.
flô re-ái bo: with white flowers.
florentí nus: Florentine.
flô re-plè no: with full or double flowers.
floribún dus: free-flowering, blooming profusely.
flór idus: flowering, full of flowers.
flù itans: floating.
fluviát ilis: pertaining to a river.
fœm ina: female.
fœniculà ceus: fennel-like.
fœtidís simus: very fetid.
fœt idus: fetid, bad-smelling.
folià tus: with leaves.
foliolà tus: with leaflets.
foliô sus: leafy, full of leaves.
folliculà ris: bearing follicles, follicled.
forfícà tus: shear-shaped.
formicæfór mis: ant-shaped, ant-like.
formosís simus: most or very beautiful.
formô sus: beautiful, handsome.

foveâ tus: pitted.
frâg ilis: fragile, brittle.
frâ grans: fragrant, odorous.
fragrantís simus: very fragrant.
fraxín eus: fraxinous, like Fraxinus or ash trees.
fríg idus: cold, of cold regions.
frondô sus: fronded, leafy.
fructíf era: fruit-bearing, fruitful.
fructíg enus: fruitful.
frutês cens: shrubby, bushy.
fruticô sus: fruticose, shrubby, bushy.
fucâ tus: painted, dyed.
fû gax: swift.
fúl gens: shining, glistening.
fúlg idus: fulgid, shining.
fuliginô sus: black-painted or -colored, sooty.
fulvês cens: fulvous or becoming fulvous.
fúlvus: fulvous, tawny, orange-gray-yellow.
funâ lis: of a rope or cord.
fû nebris: funereal.
fungô sus: fungous, pertaining to a fungus, spongy.
funiculâ tus: of a slender rope or cord; with a funicle (stalk of an ovule or seed).
fûr cans: forked.
furcâ tus: furcate, forked.
fús cus: fuscous, brown, dusky.
fusifór mis: spindle-shaped.

galericulâ tus: helmet-like.
gál licus: of Gaul or France; also pertaining to a cock or rooster.
gandavén sis: belonging to Ghent, Belgium.
gargán icus: belonging to Gargano (Eastern Italy).
gél idus: ice-cold.
geminâ tus: twin.
geminiflô rus: twin-flowered.
gemmâ tus: gemmed, jewelled; also bearing buds.
gemmíf era: bud-bearing.
genevén sis: belonging to Geneva.
geniculâ tus: jointed, kneed.
geoî des: of the earth.
geomét ricus: geometrical, in a pattern.
germán icus: German, of Germany.
gibberô sus: humped, hunchbacked.
gibbiflô rus: gibbous-flowered.
gibbô sus: swollen on one side.
gíb bus: gibbous, swollen on one side.
gigantê us: gigantic, very large.
gigánt icus: gigantic.
gî gas: of giants, immense.
glabél lus: smoothish.
glà ber: glabrous, smooth.
glabér rimus: most smooth, smoothest.
glabrâ tus: somewhat glabrous or smooth.
glabrés cens: smoothish, or becoming so.
glaciâ lis: icy, frozen.
gladiâ tus: sword-like.
glandulíf era: gland-bearing.
glandulô sus: glandular.
glastifô lius: with leaves like the dyer's woad (Isatis, once called Glastum).
glaucês cens: glaucescent, becoming glaucous.
glaucifô lius: glaucous-leaved.
glaucophýl lus: glaucous-leaved.
glaû cus: glaucous, with a bloom, grayish.
globô sus: globose, spherical, nearly or quite globular.
globulâ ris: of a little ball or sphere.
globulíf era: globule-bearing, globe-bearing.
globulô sus: globuled, like a little ball.
glomerâ tus: glomerate, clustered.
gloriô sus: glorious, superb.
glumâ ceus: glumed, with glumes or glume-like structures.
glutinô sus: glutinous, gluey, sticky.
gongylô des: roundish.
gracilén tus: slender.
grâc ilis: graceful, slender.
gracîl limus: graceful, very slender.
græ cus: of Greece, Greek.
gramín eus: grassy, grass-like.
graminifô lius: grass-leaved.
grán diceps: large-headed.
grandicús pis: with large cusps or points.
grandidentâ tus: large- or big-toothed.
grandiflô rus: large-flowered.
grandifô lius: large-leaved.
grandifór mis: on a large scale, of a big kind.
grandipunctâ tus: with large spots.
grân dis: large, big.
granulâ tus: granulate, covered with minute grains.
granulô sus: granulate, granulose.
gratís simus: very pleasing or agreeable.
grâ tus: pleasing, agreeable.
gravê olens: heavy-scented.
grœnlând icus: of Greenland.
guianên sis: of Guiana (South America).
guineén sis: of Guinea (Africa).
gummíf era: gum-bearing.
guttâ tus: spotted, speckled.
gymnocâr pus: naked-fruited.
gỹ rans: gyrating, revolving in a circle.

hæmân thus: blood-red-flowered.
hamâ tus: hooked.
hamô sus: hooked.
harpophýl lus: sickle-leaved.
hastâ tus: hastate, spear-shaped.
hastíf era: spear-bearing.
hastî lis: of a javelin or spear.
hebecâr pus: pubescent-fruited.
hederâ ceus: of the ivy (Hedera).
helián thus: sunflower.
helvét icus: Swiss, of Helvetia (Switzerland).
hêl volus: pale yellow.
hemisphær icus: hemispherical,
heptaphýl lus: seven-leaved.
herbâ ceus: herbaceous, dying to the ground and not woody.
herbarió rum: of the herbaria.
heteracán thus: various-spined.
heterán thus: various-flowered, variable in flowers.
heterocâr pus: various-fruited.
hetér odon: various-toothed.
heteroglós sus: various-tongued.
heteromór phus: various in form.
heterophýl lus: various-leaved, with leaves of more than one shape.
hexagonóp terus: six-angled-winged.
hexagô nus: hexagonal, six-angled.
hexapét alus: six-petaled.
hî ans: open, gaping.
hibernâ lis: of or pertaining to winter.
hibér nicus: Hibernian, of or pertaining to Ireland.
hieroglýph icus: hieroglyphic, marked as if with signs.
himalâ icus: Himalayan.
hircî nus: of a goat, with a goat's odor.
hirsutís simus: very hairy, most hairy.
hirsû tulus: somewhat hirsute or hairy.
hirsû tus: hirsute, hairy.
hirtél lus: somewhat hairy.
hirtiflô rus: hairy-flowered.
hír tipes: hairy-stalked or -stemmed.
hír tus: hairy.
hispán icus: Spanish, of Spain.
hispidís simus: most or very bristly.
hispíd ulus: somewhat hispid or bristly.
hís pidus: hispid, bristly.
histriôn icus: histrionic, pertaining to the stage or to actors.
holoseríc eus: woolly-silky.
horizontâ lis: horizontal.
hór ridus: provided with spines or barbs, prickly.
hortén sis: belonging to the hortus or garden.
hortíc olus: a little garden; of the garden.
hortô rum: of gardens.
hortulâ nus: pertaining to a garden.
humifû sus: sprawling on the ground.
hû milis: low-growing, dwarf.
hyacínth inus: hyacinthine, sapphire-colored.
hyacinthoî des: like the hyacinth.
hyál inus: transparent, translucent.
hýb ridus: hybrid, mixed, mongrel.
hyemâ lis: of winter; also *hiemalis*.
hygromét ricus: hygrometric, taking up water.
hymenán thus: membranaceous-flowered.
hymenô des: membrane-like.
hyperbô reus: far northern.
hypocraterifór mis: salver-shaped, flower with a slender cylindrical tube and flat spreading limb.
hypogæ us: underground, subterranean.
hypoglaû cus: glaucous beneath.
hypoleû cus: whitish, pale.
hypophýl lus: under the leaf.
hýs trix: porcupine-like, bristly.

ián thinus: violet, violet-blue.
ibér icus: of Iberia (the Spanish peninsula).
icosân drus: twenty-stamened.
ignés cens: fiery.
íg neus: fiery.
ilicifô lius: ilex-leaved, holly-leaved.
illustrâ tus: pictured.
illús tris: bright, brilliant, lustrous.
illýr icus: of Illyria (Grecian Peninsula).
imbér bis: without beards or spines.
ím bricans: imbricating.
imbricâ tus: imbricated, lapping over, shingled.
immaculâ tus: immaculate, spotless.

immĕr sus: immersed, under water.
imperà tor: commanding, imperious.
imperià lis: imperial, kingly.
implĕx us: implicated, interwoven.
imprĕs sus: impressed, sunken in.
inæqualifō lius: unequal-leaved.
inæquà lis: unequal.
inæquilāt erus: unequal-sided.
incà nus: hoary.
incarnà tus: flesh-colored.
incĕr tus: uncertain, doubtful.
incisifō lius: cut-leaved.
incī sus: incised, cut.
inclinà tus: inclined, bent downward.
incomparāb ilis: incomparable, excelling.
incŏmp tus: rude, unadorned, not attractive.
inconspĭc uus: inconspicuous, not prominent.
incurvà tus: incurved, bent inward.
incŭr vus: incurved.
indentà tus: indented, dented
ĭn dicus: Indian, of India or the East Indies.
indivĭ sus: undivided.
inĕr mis: unarmed, without thorns or spines.
infectō rius: used for dying, pertaining to dyes.
infĕs tus: dangerous, unsafe.
inflà tus: inflated, swollen up.
infortunà tus: unfortunate.
infrāc tus: broken.
infundibulifŏr mis: funnel-shaped, trumpet-shaped.
infundĭb ulum: a funnel.
inodō rus: without odor, scentless.
inornà tus: without ornament, not showy.
ĭn quinans: polluting, discoloring.
inscrĭp tus: inscribed, written on.
insĭg nis: remarkable, distinguished, marked.
insitĭt ius: grafted.
intāc tus: intact, untouched.
ĭn teger: entire.
integĕr rimus: very entire.
integrifō lius: entire-leaved.
interjĕc tus: interjected, put between.
intermē dius: intermediate.
interrŭp tus: interrupted.
intertĕx tus: interwoven, intertwined.
intricà tus: intricate, entangled.
intrŏr sus: introrse, turned inward.
intumĕs cens: swollen, puffed up, tumid.
intybà ceus: pertaining to chicory (Intybus).
invĕr sus: inverse, turned over, upside down.
invī sus: unseen, overlooked.
involucrà tus: involucred, with an involucre.
involū tus: involute, rolled inward.
ionān thus: with flowers like the violet.
ionŏp terus: with wings like the violet.
iridĕs cens: iridescent, changing color at different angles.
iridiflō rus: iris-flowered.
irregulā ris: irregular.
isān drus: with equal stamens.
isopĕt alus: equal-petaled.
isophўl lus: equal-leaved.
itāl icus: Italian.

jamaicēn sis: of Jamaica.
japōn icus: Japanese, of Japan.
jasmīn eus: jasmine-like.
jasminiflō rus: jasmine-flowered.
javān icus: Javan, of Java.
jubà tus: crested, with a mane.
jucūn dus: agreeable, pleasing.
jugō sus: joined, yoked.
jūn ceus: Juncus-like, rush-like.

kashmirià nus: of Cashmere or Kashmere.
kewĕn sis: belonging to Kew (Kew Gardens, England).
koraià nus: of Corea; also *coreanus*.

labià tus: labiate, lipped.
labiō sus: lipped.
lāch ryma: a tear.
lacinià tus: laciniate, torn, cut or slashed into narrow lobes.
laciniō sus: laciniose, laciniate.
lactà tus: milky.
lāc teus: milk-white.
lactĭc olor: milk-colored.
lactĭf era: milk-bearing, milky-juiced.
lactiflō rus: flowers milk-colored.
lacunō sus: with holes or pits.
lacūs tris: pertaining to lakes.
ladanĭf era: ladanum-bearing.
lætĕv irens: light green, vivid green.
iæ tus: bright, vivid.
lævicaŭ lis: smooth-stemmed.
lævigà tus: smooth.
lævĭ ipes: smooth-footed, smooth-stalked.
læ vis: smooth.
lævĭŭs culus: smoothish, somewhat smooth.
lanà tus: woolly.
lanceolà tus: lanceolate.
lān ceus: lance-like.
lancifō lius: lance-leaved.
lanĭg era: wool-bearing.
lanuginō sus: woolly, downy.
lappà ceus: pertaining to a globular hooked bur; Lappa-like.
lappōn icus: of Lapland.
laricifō lius: larch-leaved.
larĭc inus: Larix-like, larch-like.
lasiocār pus: rough-fruited, rough-hairy.
lasiopĕt alus: with petals rough-hairy.
lateriflō rus: lateral-flowered, with flowers on the side.
laterĭt ius: brick-red.
latifō lius: broad-leaved.
lāt ifrons: broad-fronded, broad-herbaged, broad-leaved.
latimaculā tus: broad-spotted.
lāt ipes: broad-footed, broad-stalked.
latĭs simus: broadest, very broad.
là tus: broad, wide.
laurifō lius: laurel-leaved.
laurī nus: laurel-like.
lavandulà ceus: lavender-like.
laxiflō rus: loose-flowered.
laxifō lius: loose-leaved.
lāx us: lax, open, loose.
leiān thus: smooth-flowered.
leiocār pus: smooth-fruited.
leiophўl lus: smooth-leaved.
lenticulā ris: lenticular, lens-shaped.
lĕn tus: pliant, tenacious, tough.
leontoglŏs sus: lion-tongued or -throated.

leopardī nus: leopard-spotted.
lepidophўl lus: scaly-leaved.
leprō sus: of leprosy, scurfy.
leptocaŭ lis: thin-stemmed, slender-stemmed.
leptŏc ladus: thin-stemmed or -branched.
leptōl epis: thin-scaled.
leptophўl lus: thin- or slender-leaved.
leptosĕp alus: thin-sepaled.
lĕp topus: thin- or slender-stalked.
leucān thus: white-flowered.
leucōb otrys: with white clusters.
leucocĕph alus: white-headed.
leuconeŭ rus: white-nerved.
leucophўl lus: white-leaved.
leucorhī zus: white-rooted.
libŭr nicus: of Liburnia (west of Adriatic).
lignō sus: woody.
ligulā ris: ligulate, strap-shaped.
lilāc inus: lilac.
liliiflō rus: lily-flowered.
limbà tus: bordered.
limō sus: of muddy or marshy places.
linariifō lius: linaria-leaved.
linearifō lius: linear-leaved.
linearī obus: linear-lobed.
lineà ris: linear.
lineà tus: lined, with lines or stripes.
lingulà tus: tongue-shaped.
linifō lius: linum-leaved, flax-leaved.
linophўl lus: flax-leaved.
lithospĕr mus: with seeds stone-like.
littorā lis: of the seashore.
lĭv idus: livid, bluish.
lobà tus: lobed.
lobulà ris: lobed.
loliā ceus: Lolium-like (Lolium comprises the rye-grasses).
longebracteà tus: long-bracted.
longepedunculā tus: long-peduncu-late.
longicaudā tus: long-tailed.
longiflō rus: long-flowered.
longifō lius: long-leaved.
longihamā tus: long-hooked.
longilaminā tus: with long laminæ or plates.
longīl obus: long-lobed.
longimucronā tus: long-mucronate.
lŏng ipes: long-footed, long-stalked.
longipĕt alus: long-petaled.
longipinnā tus: long-pinnate.
longiracemō sus: long-racemed.
longiscā pus: long-scaped.
longisĕp alus: long-sepaled.
iongīs pathus: long-spathed.
longispī nus: long-spined.
longīs simus: longest, very long.
longīs tylus: long-stalked.
lŏn gus: long.
lorifō lius: strap-leaved.
lū cidus: lucid, bright, shining, clear.
ludovicià nus: of Louisiana.
lugdunĕn sis: belonging to the region of Lyons.
lunā tus: lunate, moon-shaped, moon-like, crescent-shaped.
lunulā tus: somewhat moon-shaped.
lupulī nus: Lupulus-like, hop-like.
lū ridus: lurid, wan, sallow, pale yellow.
lutè olus: yellowish.
lutĕs cens: yellowish, becoming yellow.

lù teus: yellow.
luxù rians: luxuriant, thrifty.
lyrâ tus: lyrate, pinnatifid with large terminal lobe.

macilén tus: lean, meager.
macrân drus: with large anthers.
macrân thus: large-flowered.
macrób otrys: large-clustered.
macrocár pus: large-fruited.
macrocéph alus: large-headed.
macrodâc tylus: large-fingered.
macrodón tus: large-toothed.
macropét alus: with large petals.
macrophýl lus: large-leaved.
macroplec tron: large-spurred.
macróp odus: large-footed or -stalked.
macróp terus: large-winged.
macrospâ dix: with large spadix.
macrostâ chyus: large-spiked.
macrostè gius: large-decked.
macrostè mus: with large filaments.
macrós tylus: large-styled.
macroù rus: large-tailed.
maculâ tus: spotted.
maculò sus: spotted.
mæsì acus: of Moesia, ancient name of Bulgaria and Servia.
magellân icus: Straits of Magellan region.
magníf icus: magnificent, eminent, distinguished.
majâ lis: of May, Maytime.
majést icus: majestic.
mâ jor, mâ jus: greater, larger.
malabár icus: of Malabar (in British India).
malifór mis: apple-formed.
malvâ ceus: Malva-like, mallow-like.
mammò sus: breasted, with breasts.
manicâ tus: manicate, long-sleeved, covered densely as with thick hairs so that the covering can be removed as such.
marcés cens: withering but not falling.
mâr cidus: withering but not falling off.
margarità ceus: pearly, of pearls.
marginâ lis: marginal, marked in some way along the margins or edges.
marginâ tus: margined.
marginél lus: somewhat margined.
marilând icus: of the Maryland region; also written *marylandicus*.
marít imus: maritime, of the sea.
marmorâ tus: marbled, mottled.
marmò reus: marbled.
marmorophýl lus: leaves marbled.
maroccâ nus: of Morocco.
más: male.
masculâ tus: masculine.
más culus: male, masculine.
matronâ lis: pertaining to matrons.
mauritân icus: of Mauretania (N. Africa).
maxillâ ris: maxillary, of the jaw.
mâx imus: largest.
mediterrâ neus: of the Mediterranean region.
mè dius: medium, intermediate.
medullâ ris: of the marrow or center or pith.
megalân thus: large-flowered.
megaphýl lus: large-leaved.
megapotâm icus: of the large river.
megarrhì zus: large-rooted.
megaspér mus: large-seeded.
megastâ chyus: large-spiked.
megastíg mus: with large stigma.
melanân thus: black-flowered.
melanchól icus: melancholy, hanging or drooping.
melanocaù lon: black-stemmed.
melanocóc cus: black-berried.
melanoleù cus: black-and-white.
melanóx ylon: black-wooded.
meleâ gris: like a guinea-fowl, speckled.
mél leus: pertaining to honey.
mellíf era: honey-bearing.
melofór mis: melon-shaped.
membranâ ceus: membranaceous, membranous, thin and more or less translucent.
meniscfò lius: crescent-leaved.
mesoleù cus: mixed with white.
metál licus: metallic (color or luster).
mexicâ nus: Mexican, of Mexico.
mì cans: glittering, sparkling, mica-like.
micrân thus: small-flowered.
microcár pus: small-fruited.
míc rodon: small-toothed.
microglós sus: small-tongued.
micról epis: small-scaled.
microm eris: small-numbered, of small number of parts.
micropét alus: small-petaled.
microphýl lus: small-leaved.
microp terus: small-winged.
microsép alus: small-sepaled.
microstè mus: of small filaments or stemlets.
militâ ris: military.
millefolià tus: thousand-leaved.
millefò lius: thousand-leaved, leaves or parts very many.
mì mus: mimic.
mì nax: threatening, forbidding.
miniâ tus: cinnabar-red.
mín imus: least, smallest.
mi nor, mì nus: smaller.
minutís simus: very or most minute.
minù tus: minute, very small.
mirâb ilis: marvellous, extraordinary, wonderful.
mistassín icus: of Lake Mistassini, (Quebec).
mì tis: mild, gentle.
mitrâ tus: turbaned.
míx tus: mixed.
modés tus: modest.
moldáv icus: of Moldavia (in Rumania).
mól lis: soft, soft-hairy.
mollís simus: very soft-hairy.
moluccâ nus: of the Moluccas (East Indies).
monadél phus: in one group or bundle.
mongól icus: of Mongolia.
monilíf era: bearing a necklace.
monacán thus: one-spined.
monocéph alus: single-headed.
monóg ynus: of one pistil.
monoì cus: monœcious.
monopét alus: one-petaled.
monophýl lus: one-leaved.
monóp terus: one-winged.
monopyrè nus: bearing one stone or pyrene.
monosép alus: one-sepaled.
monospér mus: one-seeded.
monostâ chyus: single-spiked.
monspelién sis: of Montpelier.
monspessulâ nus: of Montpelier.
monstrò sus: monstrous, wholly abnormal or deformed, teratological.
montâ nus: pertaining to mountains or mountainous regions.
montevidén sis: of Montevideo (Uruguay).
montíc olus: native of mountains.
moschâ tus: musky, musk-scented.
mucronâ tus: mucronate, tipped with a short sharp point or mucro.
mucronulâ tus: with a small mucro or point.
multibracteâ tus: many-bracted.
multicaù lis: many-stemmed, with numerous stems.
múl ticeps: many-headed, many branched.
multíc olor: many-colored.
multíf idus: multifid, many times parted.
multiflò rus: many-flowered.
multifurcâ tus: much-forked, many times forked.
multíj ugus: many in a yoke, many times joined.
multinér vis: many-nerved.
múl tiplex: many-folded.
multiradiâ tus: many-radiate, with numerous rays.
multiséc tus: many times cut, much cut or dissected.
mún dulus: trim, neat.
munì tus: defended, fortified.
murâ lis: of walls, growing on walls.
muricâ tus: muricate, roughed by means of hard points.
muscíp ula: a mouse-trap.
mutâb ilis: changeable, variable, mutant.
mutâ tus: changeable.
mù ticus: blunt, pointless.
mutilâ tus: mutilated.
myriacán thus: numberless spined, very many-spined.
myriocár pus: very many-fruited.
myrmecóph ilus: ant-loving.
myrtifò lius: myrtle-leaved.

nà nus: dwarf.
napifór mis: turnip-shaped.
narbonén sis: of Narbonne (ancient region or province of S. France).
nà tans: floating, swimming.
naviculâ ris: pertaining to a ship.
neapolità nus: Neapolitan.
nebulò sus: nebulous, clouded, indefinite, obscure.
neglec tus: neglected, overlooked.
nemorâ lis: of groves or woods.
nemorò sus: of groves or woods and shady places.
nepalén sis: of Nepal (Himalayan region).
neriifò lius: nerium-leaved, oleander-leaved.
nervò sus: nerved.
nevadén sis: of the Sierra Nevadas (in Spain or N. America).
níc titans: blinking, moving.
nì dus: nest.
nì ger: black.

nigrâ tus: blackish.
nigrés cens: blackish, becoming black.
níg ricans: black.
nigricôr nis: black-horned.
níg ripes: black-footed or -stalked.
nilôt ica: of the Nile.
nì tens: shining.
nít idus: shining.
nivà lis: snowy, pertaining to snow.
nív eus: snowy.
nivô sus: snowy, full of snow.
nobîl ior: more noble.
nôb ilis: noble, famous, renowned.
nobilís simus: most or very noble.
nodiflô rus: with flowers at nodes.
nodô sus: with nodes, jointed.
nonscríp tus: undescribed.
nootkatên sis: of Nootka (Nootka Sound is by Vancouver Island).
notâ tus: marked.
nô væ-ân gliæ: of New England.
nô væ-cæsarĕ æ: of New Jersey.
nô væ-zealând iæ: of New Zealand.
noveboracên sis: of New York.
nô vi-bél gii: of New Belgium or New Netherlands (i. e., New York).
nubíc olus: dwelling among clouds.
nucíf era: nut-bearing.
nudâ tus: nude, stripped.
nudicaû lis: naked-stemmed.
nudiflô rus: naked-flowered.
nû dus: nude, naked.
numismâ tus: pertaining to money, coin-like.
nû tans: nodding.
nyctíc alus: night-blooming.

obcôn icus: inversely conical.
obcordâ tus: obcordate, inversely cordate.
obè sus: obese, fat.
obfuscâ tus: clouded, confused.
oblî quus: oblique, unequal and slanting.
obliterâ tus: obliterated, erased, not apparent.
oblongâ tus: oblong.
oblongifô lius: oblong-leaved.
oblón gus: oblong.
obovâ tus: obovate, inverted ovate.
obscû rus: obscure, hidden.
obsolè tus: obsolete, rudimentary.
obtusâ tus: obtuse, blunt.
obtusifô lius: blunt-leaved.
obtusîl obus: blunt-lobed.
obtû sus: obtuse, blunt, rounded.
occidentâ lis: occidental, western.
oceán icus: oceanic; perhaps of Oceanica.
ocellâ tus: eyeleted, with small eyes.
ochreâ tus: with an ochrea or boot-sheath.
ochroleû cus: yellowish white.
octân drus: with eight anthers.
octopêt alus: eight-petaled.
octophýl lus: eight-leaved.
oculâ tus: eyed, with eye-like marks.
odontî tes: tooth.
odontochî lus: with toothed lip or margin.
odoratís simus: most or very odorous, very fragrant.
odorâ tus: odorous, fragrant.
odô rus: odorous, fragrant.
officinâ lis: officinal, medicinal, recognized in the pharmacopea.
officinâ rum: of the apothecaries.
oleæfô lius: Olea- or olive-leaved.
oleîf era: oil-bearing.
olerâ ceus: oleraceous, vegetable-garden herb used in cooking.
oligân thus: few-flowered.
oligocâr pus: few-fruited.
oligospêr mus: few-seeded.
olitô rius: pertaining to vegetable-gardens or -gardeners.
olivâ ceus: olive-like, olive-colored.
olivæfôr mis: olive-shaped.
olým picus: of Olympus or Mt. Olympus (in Greece).
omnív orus: omnivorous, of all kinds of food.
opâ cus: opaque, shaded.
operculâ tus: with a lid.
oppositiflô rus: opposite-flowered.
oppositifô lius: opposite-leaved.
opuliflô rus: flowers of Opulus (a Viburnum).
orbiculâ ris: round.
orbiculâ tus: round.
orchíd eus: orchid-like.
orchioî des: orchid-like.
oregâ nus: of Oregon.
orgyâ lis: length of the arms extended, about 6 feet.
orientâ lis: oriental, eastern.
ornatís simus: most showy or ornate.
ornâ tus: ornate, adorned.
ornithocéph alus: like a bird's head.
ornithóp odus: like a bird's foot.
ornithorhýn chus: shaped like a bird's beak.
orthocâr pus: straight-fruited.
orthochî lus: straight-lipped.
orthôp terus: straight-winged.
ovalifô lius: oval-leaved.
ovâ lis: oval.
ovatifô lius: ovate-leaved.
ovâ tus: ovate.
ovíf era: egg-bearing.
ovíg era: egg-bearing.
ovî nus: pertaining to sheep.
oxyacán thus: sharp-thorned or -spined.
oxygô nus: sharp-angled.
oxyphýl lus: sharp-leaved.
oxysép alus: with sharp sepals.

pachyân thus: thick-flowered.
pachyneû rus: thick-nerved.
pachýp terus: thick-winged.
pacíf icus: of the Pacific, of regions bordering the Pacific Ocean.
palæstî nus: of Palestine.
paleâ ceus: with palea (bracts in grass flowers), or palea-like, chaffy.
pâl lens: pale.
pallés cens: palish, becoming pale.
palliâ tus: palliated, cloaked.
pallidiflô rus: pale-flowered.
pallidifô lius: pale-leaved.
pallidispî nus: pale-spined.
pâl lidus: pale.
palliflâ vens: pale yellow.
palmatîf idus: palmately cut.
palmâ tus: palmate, divided or lobed like the hand.
paludô sus: of marshes, marsh-loving.
palús tris: marsh-loving.
pandurâ tus: fiddle-shaped.
paniculâ tus: paniculate.
paniculíg era: panicle-bearing.
pannôn icus: of Pannonia (Roman province on the Danube, now western Hungary).
pannô sus: ragged, tattered.
papaverâ ceus: Papaver-like, poppy-like.
papilionâ ceus: butterfly-like, the form of the pea flower.
papillô sus: papillate, with minute nipple-like projections or protuberances.
papyrâ ceus: papery.
papyrîf era: paper-bearing.
paradisî acus: of parks or gardens.
paradóx us: paradoxical, strange.
parasít icus: parasitical, of a parasite.
pardalî nus: leopard-like, spotted.
pardî nus: leopard-spotted.
partî tus: parted.
parviflô rus: small-flowered.
parvifô lius: small-leaved.
parvís simus: smallest, very small.
pâr vulus: very small, very slight.
pâr vus: small.
patagôn icus: of Patagonia.
patellâ ris: circular, disk-shaped, like a knee-pan.
pâ tens: spreading.
pát ulus: spreading.
pauciflô rus: few-flowered.
paucifô lius: few-leaved.
paupêr culus: poor.
pavonî nus: peacock-like.
pectinâ ceus: pectinate.
pectinâ tus: pectinate, comb-like, pinnatifid with very narrow close divisions or parts.
pectiníf era: comb-bearing.
pectorâ lis: shaped like a breast-bone
pedâ tus: footed, of the foot or feet; also pedate, like a bird's foot, being palmately divided and the side parts 2-cleft.
pedemontâ nus: of Piedmont (northern Italy).
pedunculâ ris: peduncled, stalked.
pedunculâ tus: peduncled.
pedunculô sus: with many peduncles.
pellû cidus: pellucid, with translucent dots.
peltâ tus: peltate.
peltifô lius: peltate-leaved.
pelvifôr mis: pelvis-shaped.
penduliflô rus: pendulous-flowered.
pendulî nus: somewhat pendulous.
pén dulus: pendulous, hanging.
penicillâ tus: hair penciled, like a little brush; pinnate.
pennâ tus: feathered, as the veins or lobes standing off at right angles from a midrib; pinnate.
penninêr vis: feather-veined.
pennsylvân icus: of Pennsylvania.
pentagô nus: five-angled.
pentâg ynus: of five pistils.
pentân drus: of five stamens.
pentân thus: five-flowered.
pentaphýl lus: five-leaved.
perbél lus: very beautiful.
peregrî nus: exotic, foreign, from a strange country.
perén nans: perennial.
perén nis: perennial, living three or more years.
perfoliâ tus: perfoliate, with leaf surrounding the stem.

perforâ tus: perforated, with holes.
permíx tus: much mixed or confused.
persicæfô lius: peach-leaved.
pêr sicus: of Persia; also the peach.
perspíc uus: clear, transparent.
pertû sus: thrust through, forced through, perforated.
peruviâ nus: Peruvian, of Peru.
petaloíd eus: petal-like.
petiolâ ris: petioled, with a leaf-stalk.
petiolâ tus: petioled.
petræ us: rock-loving.
phlogiflô rus: flame-flowered.
phœníc eus: purple-red.
phrýg ius: of Phrygia (in Asia Minor).
phyllomanî acus: running wildly to leaves, leafy.
picturâ tus: painted-leaved, pictured, variegated.
píc tus: painted.
pilíf era: bearing soft hairs.
pilosiûs culus: somewhat or slightly pilose.
pilô sus: pilose, shaggy, with soft hairs.
pilulíf era: globule-bearing.
pinetô rum: of pine forests.
pín eus: of the pine.
pinifô lius: pine-leaved.
pinnatíf idus: pinnatifid, pinnately cleft.
pinnât ifrons: pinnate-fronded or -foliaged.
pinnatinér vis: pinnate-nerved.
pinnâ tus: pinnate, with leaflets on the sides of a main leaf axis.
pisíf era: Pisum-bearing, pea-bearing.
pisocâr pus: pea-fruited.
placâ tus: quiet, calm.
planiflô rus: plane-flowered, flat-flowered.
planifô lius: flat-leaved.
plantagín eus: plantain-like.
plâ nus: plane, flat.
platanoî des: Platanus-like, plane-tree-like.
platycân thus: broad-spined.
platycâr pus: broad-fruited.
platýc ladus: broad-branched.
platyglôs sus: broad-tongued.
platyphýl lus: broad-leaved.
plenís simus: very full or double.
plè nus: full, used to designate doubleness in flowers (as in *flore-pleno*).
pleurós tachys: side-spiked.
plicâ tus: plicate, plaited, folded lengthwise.
plumâ rius: plumed.
plumâ tus: plumed.
plûm beus: of lead.
plumô sus: feathery.
poculifôr mis: deep cup-shaped.
podocâr pus: with stalked fruit.
poét icus: pertaining to poets
polifô lius: Polium-leaved, white-leaved.
polî tus: polished.
polyacân thus: many-spined.
polyán drus: of many stamens.
polyán thus: many-flowered.
polycéph alus: many-headed.
polydâc tylus: many-fingered.
polýg amus: polygamous, having both perfect and imperfect flowers.
polymôr phus: of many forms, variable.
polypêt alus: many-petaled.
polyphýl lus: many-leaved.
polyspér mus: many-seeded.
polystâ chyus: many-spiked.
polystíc tus: many-dotted.
pomâ ceus: pome-like, resembling the apple or pear.
pomeridiâ nus: afternoon.
ponderô sus: ponderous, heavy, weighty.
pón ticus: of Pontus (in Asia Minor).
populifô lius: populus-leaved, poplar-leaved.
popúl neus: pertaining to poplars.
porcî nus: pertaining to swine.
porrifô lius: Porrum- or leek-leaved.
præál tus: very tall.
præ cox: precocious, premature, very early.
præ stans: distinguished, excelling.
prætéx tus: bordered.
prasinâ tus: greenish.
prasî nus: grass-green.
pratén sis: of meadows.
precatô rius: praying, prayerful.
primúl inus: primrose-like.
prín ceps: princely, first.
prismât icus: prismatic, prism-shaped.
proboscíd eus: proboscis-like.
procè rus: tall.
procúm bens: procumbent, lying on the ground.
procúr rens: extended.
produc tus: produced, lengthened.
profû sus: profuse.
prolíf era: producing offshoots, bearing abnormal supernumerary parts.
prolíf icus: prolific, fruitful.
propén dens: hanging down.
propín quus: related, near to.
prostrâ tus: prostrate, lying flat.
protrû sus: protruding.
provinciâ lis: provincial; or of Provence, southern France.
pruinâ tus: pruinose.
pruinô sus: pruinose, with a hoary or frost-like bloom.
prunifô lius: plum-leaved.
prû riens: itching.
pseud- **pseudo-**: in combinations means *false, not genuine, not the true* or *the typical*, as Pseudotsuga, false tsuga.
psittacî nus: of the parrot.
pû bens: downy.
pubér ulus: puberulous, somewhat pubescent.
pubés cens: pubescent, downy.
pudî cus: bashful, retiring, shrinking.
pulchél lus: pretty, beautiful.
púl cher: handsome, beautiful.
pulchér rimus: very handsome.
púl lus: dark colored, dusky, almost black.
pulverulén tus: powdered, dust-covered.
pulvinâ tus: cushioned, cushion-like.
pû milus: dwarf.
punctatís simus: most spotted, very spotted.
punctâ tus: punctate, dotted.
pún gens: piercing, sharp-pointed.
puníc eus: reddish purple.
purpurâ ceus: purple.
purpurâs cens: purplish, becoming purple.
purpurâ tus: purple.
purpû reus: purple.
pusíl lus: very small, insignificant.
pycnacân thus: densely spined.
pycnân thus: densely flowered.
pygmæ us: pigmy.
pyramidâ lis: pyramidal.
pyrenâ icus: of the Pyrenees.
pyrifô lius: pear-leaved.
pyrifór mis: Pyrus-formed, pear-shaped.

quadrangulâ ris: quadrangular, four-angled.
quadrangulâ tus: four-angled.
quadrâ tus: in four or fours, squared.
quadríc olor: of four colors.
quadridentâ tus: four-toothed.
quadríf idus: four-cut.
quadrifô lius: four-leaved.
quadripartî tus: four-parted.
quadrivâl vis: four-valved.
quercifô lius: Quercus-leaved, oak-leaved.
quercî nus: of Quercus the oak.
quinâ tus: quinate, in fives.
quinquéc olor: five-colored.
quinqueflô rus: five-flowered.
quinquefô lius: five-leaved.
quinqueloculâ ris: five-loculed, of five cells or compartments.
quinquenér vis: five-nerved.
quinquepunctâ tus: five-spotted.

racemiflô rus: raceme-flowered.
racemô sus: racemose, flowers in racemes.
radiâ tus: radiate, rayed.
radî cans: rooting.
radicô sus: many-rooted.
radî cum: of roots.
radiô sus: radiate, with many rays.
ramentâ ceus: bearing a hair-like covering.
ramiflô rus: with branching inflorescence.
ramosís simus: most- or much-branched.
ramô sus: branched.
raníf era: bearing frogs.
rapâ ceus: pertaining to rape or turnips.
rariflô rus: scattered-flowered, with flowers loose or few.
râ rus: rare, uncommon.
raû cus: hoarse, raw.
reclinâ tus: reclined, bent back.
réc tus: straight, upright.
recurvâ tus: recurved.
recurvifô lius: recurved-leaved.
recûr vus: recurved, curved back.
redivî vus: restored, brought to life.
reduplicâ tus: duplicated again, doubled again, redoubled.
refléx us: reflexed, bent back.
refrâc tus: broken, broken in pieces.
refúl gens: brightly shining, reflecting light or color.
regâ lis: regal, royal.
Regî na: Queen.
rè gius: regal, royal, kingly, pertaining to a king.
religiô sus: used for religious purposes, venerated.

remō tus: remote, with parts distant.
renifŏr mis: reniform, kidney-shaped.
repān dus: repand, with margin wavy.
rè pens: repent, creeping.
rép tans: creeping.
reséc tus: cut off, curtailed, pruned.
resinō sus: resin-bearing, full of resin.
reticulā tus: reticulate, netted, net-veined.
retŏr tus: twisted back.
retroflĕx us: reflexed.
retū sus: retuse, notched slightly at a rounded apex.
revér sus: reversed, end-for-end.
revolū tus: revolute, rolled backward from the margins.
Rex: king.
rhamnifō lius: Rhamnus-leaved, buckthorn-leaved.
rhizophýl lus: root-leaved, acaulescent.
rhodān thus: rose-flowered.
rhodochī lus: rose-lipped or -margined.
rhodocínc tus: rose-girdled.
rhodoneū rus: red-nerved.
rhomboíd eus: rhomboidal.
ricinifō lius: Ricinus-leaved, with leaves of castor-oil plant.
rigíd ulus: somewhat stiff or rigid.
ríg idus: rigid, stiff.
rín gens: ringent, gaping, open-mouthed.
ripā rius: of river banks.
rivā lis: pertaining to brooks.
rivulā ris: brook-loving.
robús tus: robust, stout.
rosā ceus: rose-like.
rosæflō rus: rose-flowered.
rō seus: rose, rosy.
rostrā tus: rostrate, beaked.
rosulā ris: rosulate, in rosettes.
rotā tus: rotate, wheel-shaped.
rotundifō lius: round-leaved.
rotún dus: rotund, round.
rubél lus: reddish.
rū bens: red, ruddy.
rù ber: red, ruddy.
rubér rimus: very red.
rubés cens: reddish, becoming red.
rubiæfō lius: rubus- or bramble-leaved.
rubicún dus: rubicund, red.
rubiginō sus: rusty.
rubricaū lis: red-stemmed.
rubrifō lius: red-leaved.
rubronér vis: red-veined.
rufés cens: reddish, becoming red.
rufinér vis: red-nerved.
rū fus: red, reddish.
rugō sus: rugose, wrinkled.
runcinā tus: runcinate, retrorsely or backwardly incised or toothed.
rupés tris: rock-loving.
rupíc olus: growing on cliffs or ledges.
rús ticus: rustic, belonging to the country.
ruthén icus: Ruthenian, Russian.
rù tilans: red, becoming red.

saccā tus: saccate, bag-like.
saccharā tus: containing sugar, sweet.
saccharíf era: sugar-bearing.
saccharī nus: saccharine.
sác charum: sugar.
saccíf era: bag-bearing.
sachalinén sis: of Saghalien Isl. (N. Japan).
sagittā lis: of the arrow, sagittate.
sagittā tus: sagittate, arrow-like.
sagittifō lius: arrow-leaved.
salicifō lius: salix-leaved, willow-leaved.
salíc inus: willow-like.
salíg nus: of the willow.
sali nus: salty.
sambū cinus: sambucus- or elder-like.
sānc tus: holy.
sandwicén sis: of the Sandwich or Hawaiian Isls.
sanguín eus: bloody, blood-red.
sāp idus: savory, pleasing to taste.
sapién tum: of the wise men or authors.
saponā ceus: soapy.
sarcō des: flesh-like.
sarmāt icus: of Sarmātia (an ancient territory in S. Russia and Poland).
sarmentō sus: sarmentose, bearing runners.
satī vus: cultivated.
saurocéph alus: lizard-headed.
saxāt ilis: found among rocks.
saxíc olus: growing among rocks.
saxō sus: full of rocks.
scā ber: scabrous, rough.
scabrél lus: somewhat scabrous.
scán dens: scandent, climbing.
scapō sus: with scapes.
scép trum: of a scepter.
schizoneū rus: cut-nerved.
schizopét alus: cut-petaled.
schizophýl lus: cut-leaved.
scholā ris: pertaining to a school.
sclerocár pus: hard-fruited.
sclerophýl lus: hard-leaved.
scót ica: Scotch, of Scotland.
scúlp tus: carved.
scutellā ris: salver- or dish-shaped.
scū tum: a shield.
sebíf era: tallow-bearing.
sebō sus: full of tallow or grease.
sechellā rus: of the Seychelles (Indian Ocean).
secún dus: secund, side-flowering.
securíg era: axe-bearing.
ség etum: of cornfields.
semialā tus: semi-winged, half or somewhat winged.
semicaudā tus: semi- or partially tailed.
semicylín dricus: semi- or somewhat cylindrical.
semipinnā tus: half or imperfectly pinnate.
semperflō rens: ever flowering.
sempér virens: ever green.
senī lis: senile, old, white-haired.
sensíb ilis: endowed with feeling, sensitive.
sensiti vus: sensitive.
sepiā rius: pertaining to hedges.
sè pium: of hedges or fences.
septangulā ris: seven-angled.
septém lobus: seven-lobed.
septempunctā tus: seven-spotted.
septentrionā lis: northern, belonging to the North.
sepúl tus: sepulchered, interred.
seríc eus: silky.
serōt inus: late, late-flowering or late-ripening.
sér pens: creeping, crawling.
serpentī nus: of snakes, serpentine, looping or waving.
serratifō lius: serrate-leaved, saw-edge-leaved.
serrā tus: serrate, saw-toothed.
serrulā tus: serrulate, somewhat serrate.
sesquipedā lis: one foot and a half long or high.
sessiflō rus: sessile-flowered, without pedicel.
sessifō lius: sessile-leaved, without petiole.
sessilifō lius: sessile-leaved.
sés silis: sessile, stalkless, sitting.
setā ceus: setaceous, bristle-like.
setíg era: bristly, bristle-bearing.
setō sus: setose, full of bristles.
setulō sus: full of small bristles.
sibír icus: of Siberia.
signā tus: marked, designated, attested.
sikkimén sis: of Sikhim or Sikkim (N. India).
silíc eus: pertaining to or growing in sand.
siliculō sus: bearing silicles.
silvāt icus: pertaining to woods, sylvan; sometimes *sylvaticus*.
silvés tris: pertaining to woods.
sím plex: simple, unbranched.
simplicicaū lis: simple-stemmed.
simplicifō lius: simple-leaved.
simplicís simus: simplest, very unbranched.
sím ulans: similar to, resembling.
sinén sis: Chinese, of China.
sín icus: Chinese.
sinuā tus: sinuate, wavy-margined.
sinuō sus: sinuate.
sitchén sis: belonging to Sitka, Alaskan.
smarág dinus: of emerald.
smilác inus: of smilax.
sobolíf era: bearing creeping rooting stems or shoots.
sociā lis: sociable, companionable.
socotrā nus: of the Island of Socotra (south of Arabia).
solā ris: solar, of the sun.
sól idus: solid, dense, not hollow.
somníf era: sleep-producing.
sór didus: dirty, unclean, foul.
spadíc eus: with a spadix.
sparsiflō rus: sparsely or few-flowered.
sparsifō lius: sparsely or few-leaved.
spár sus: sparse, scattered, few.
spár teus: pertaining to the broom.
spathā ceus: with a spathe.
spathulā tus: spatulate, spoon-shaped, narrowed toward the base from a rounded top.
speciosís simus: very showy.
speciō sus: showy, good-looking.
spectāb ilis: spectacular, worth seeing, remarkable, showy.
spectān dus: showy.
spéc trum: an image, apparition.
sphacelā tus: dead, withered, diseased.
sphær icus: spherical.
sphærocár pus: spherical-fruited.
sphærocéph alus: spherical-headed.
sphæroíd eus: sphere-like.
sphærostā chyus: spherical-spiked.

spicâ tus: spicate, with spikes.
spicíg era: spike-bearing.
spinosís simus: most or very spiny.
spinô sus: full of spines.
spinulíf era: bearing small spines.
spinulô sus: somewhat or weakly spiny.
spirâ lis: spiral.
spirél lus: a spiral, little spiral.
splén dens: splendid.
splendidís simus: very splendid.
splén didus: splendid.
spumâ rius: frothing, of froth or spume.
spû rius: spurious, false, bastard.
squâ lens: daubed, filthy.
squál idus: squalid, filthy.
squamâ tus: squamate, with squamæ or small scale-like leaves or bracts.
squamô sus: squamate, full of scales.
squarrô sus: squarrose, with parts spreading or even recurved at ends.
stamín eus: bearing prominent stamens.
stâns: standing, erect, upright.
stauracân thus: with spines cross-shaped.
stellâ ris: starry.
stellâ tus: stellate, starry.
stellulâ tus: of little stars.
stenocéph alus: narrow-headed.
stenóg ynus: with a narrow stigma.
stenopêt alus: narrow-petaled.
stenophýl lus: narrow-leaved.
stenóp terus: narrow-winged.
stér ilis: sterile, infertile.
stigmât icus: marked, of stigmas.
stigmô sus: much marked, pertaining to stigmas.
stipulâ ceus: stipuled, with stipules.
stipulâ ris: stipuled.
stipulâ tus: stipuled.
stoloníf era: bearing stolons or runners that take root.
stramín eus: straw-colored.
strangulâ tus: strangled, constricted.
streptocâr pus: twisted-fruited.
streptopêt alus: with petals twisted.
streptophýl lus: twisted-leaved.
streptoaép alus: with sepals twisted.
striât ulus: somewhat or faintly striped.
striâ tus: striated, striped.
strictiflô rus: strict- or stiff-flowered.
stríc tus: strict, upright, erect.
strigillô sus: somewhat strigose.
strigô sus: strigose, covered with sharp straight appressed hairs.
striguló sus: beset with small or weak appressed hairs.
striolâ tus: striolate, somewhat or faintly striped.
strobilíf era: cone-bearing.
strumâ rius: of tumors or ulcers.
strumâ tus: with tumors or ulcers.
stylô sus: with style or styles prominent.
styracíf luus: flowing with storax or gum.
suavê olens: sweet-scented.
suâ vis: sweet, agreeable.
suavís simus: sweetest, very sweet-scented.
subacaû lis: somewhat stemmed, nearly stemless.
subalpî nus: subalpine, nearly alpine.
subauriculâ tus: somewhat or rather auricled or eared.
subcarnô sus: nearly or rather fleshy.
subcordâ tus: partially or imperfectly or somewhat cordate.
subedentâ tus: nearly toothless.
suberculâ tus: of cork, corky.
suberéc tus: somewhat or rather erect.
suberô sus: cork-barked, full of cork.
subfalcâ tus: somewhat falcate.
subglaû cus: somewhat or to some degree glaucous.
subhirtél lus: somewhat hairy.
sublunâ tus: somewhat lunate or crescent-shaped.
submér sus: submerged, under water.
subperén nis: imperfectly or nearly perennial.
subpetiolâ tus: somewhat or partially petioled.
subsés silis: nearly sessile, not completely sessile.
subsinuâ tus: somewhat sinuate or wavy-margined.
subterrâ neus: subterranean, underground.
subulâ tus: subulate, awl-shaped.
subumbellâ tus: somewhat or incompletely umbellate.
subvillô sus: somewhat villose or soft-hairy.
subvolû bilis: somewhat twining.
succulén tus: succulent, fleshy.
suéc icus: Swedish, of Sweden.
suffrutés cens: slightly shrubby, becoming somewhat shrubby.
suffruticô sus: slightly shrubby.
sulcâ tus: sulcate, furrowed.
sulphû reus: sulfur-colored.
sumatrâ nus: of the Isl. of Sumatra.
supérb iens: superb, proud.
supér bus: superb, proud.
superciliâ ris: eyebrow-like.
supér fluus: superfluous, redundant.
surculô sus: producing suckers.
surinamên sis: belonging to Surinam (Dutch Guiana).
susiâ nus: of the province of Susiana (Persia).
suspén sus: suspended, hung.
sylvât icus: sylvan, forest-loving (also written *silvaticus*).
sylvés tris: of woods or forests.
sylvíc olus: growing in woods
syphilít icus: syphilitic.
syrî acus: Syrian, of Syria.
sýs tylus: with styles joined.

tabulâ ris: pertaining to tablets.
tabulifór mis: tablet-formed.
tædíg era: torch-bearing, resin-bearing.
taraxicifô lius: Taraxicum- or dandelion-leaved.
tardiflô rus: late-flowered.
tardî vus: tardy, late.
tatâr icus: of Tartary (old name for Central Asia).
taû reus: of oxen.
taû ricus: Taurian, Crimean.
taurî nus: bull-like.
taxifô lius: Taxus-leaved, yew-leaved.
tectô rum: of roofs or houses.
téc tus: concealed.
temulén tus: drunken.
tenacís simus: most tenacious.
tè nax: tenacious, strong.
tenebrô sus: of dark or shaded places.
tenél lus: slender, tender, soft.
tén er: slender, tender, soft.
tentaculâ tus: with tentacles or short projecting parts.
tenuicaû lis: slender-stemmed.
tenuiflô rus: slender-flowered.
tenuifô lius: slender-leaved.
tenuíl obus: slender-lobed.
tenû ior: more slender.
tén uis: slender, thin.
tenuís simus: very slender, very thin.
terebínth inus: of turpentine.
tè res: terete, circular in cross-section.
teretifô lius: terete-leaved.
terminâ lis: terminal, at the end of a stem or branch.
ternâ tus: in threes, ternate.
ternifô lius: with leaves in threes.
terrês tris: of the earth, terrestrial.
tessellâ tus: tessellate, laid off in squares or in dice-like pattern.
testâ ceus: light brown, brick-colored; also testaceous, bearing a prominent testa or outer seed-coat.
testiculâ tus: testiculated, testicled.
testudinâ rius: like a tortoise-shell.
tetracân thus: four-spined.
tetragô nus: four-angled.
tetrân drus: four-anthered.
tetrân thus: four-flowered.
tetraphýl lus: four-leaved.
tetráp terus: four-winged.
tetraquê trus: four-cornered.
texâ nus, texén sis: of Texas, belonging to Texas.
theíf era: tea-bearing.
thermâ lis: warm, of warm springs.
thuyoî des: like Thuja or arbor-vitæ.
thyrsiflô rus: Thyrse-flowered.
thyrsoíd eus: thyrse-like.
tibíc inis: of a flute player.
tigrî nus: tiger-striped.
tinctô rius: belonging to dyers, of dyes.
tínc tus: dyed.
tipulifór mis: of the shape of a daddy-long-legs.
tomentô sus: tomentose, matted-pubescent.
torminâ lis: useful against colic.
torô sus: torose, cylindrical with contractions at certain places or at intervals.
tôr tilis: twisted.
tortuô sus: much twisted.
tôr tus: twisted.
torulô sus: somewhat torose.
toxicâ rius: poisonous.
tóx icus: poisonous.
toxíf era: poison-producing.
transpâ rens: transparent.
trapezifór mis: trapezium-formed, a four-sided figure of which no two sides are alike.
trapezioî des: trapezium-like.
tremuloî des: like Tremulus, the trembling poplar.
trém ulus: quivering, trembling.
triacân thus: three-spined.
triân drus: with three anthers or stamens.

triangulà ris: three-angled.
triangulà tus: three-angled.
triân gulus: three-angular.
tricaudà tus: three-tailed.
trichophýl lus: hairy-leaved.
trichosán thus: hairy-flowered.
trichospér mus: hairy-seeded.
trichôt omua: thrice branched or forked.
tríc olor: three-colored.
tricór nis: three-horned.
tricuspidà tus: three-cusped, three-pointed.
tridác tylus: three-fingered.
trî dens: with three teeth.
tridentà tus: three-toothed.
trifascià tus: three-banded.
tríf idus: three-parted.
triflô rus: three-flowered.
trifolià tus: three-leaved.
trifoliolà tus: three-leafleted.
trifô lius: three-leaved.
trifurcà tus: trifurcate, thrice-forked.
trilineà tus: three-lined.
trilobà tus: three-lobed.
trîl obus: three-lobed.
trimés tris: of three months.
trinér vis: three-nerved.
trinotà tus: three-marked or -spotted.
tripartî tus: three-parted.
tripét alus: three-petaled.
triphýl lus: three-leaved.
tríp teris: three-winged.
tripunctà tus: three-spotted.
triquê trus: three-cornered.
trís tis: sad, bitter, dull.
triternà tus: triternate, thrice in threes.
triúm phans: triumphant.
trivià lis: common, ordinary, very frequent, found everywhere.
trôp icus: of the tropics.
truncât ulus: somewhat or partially truncate.
truncà tus: truncate, cut off square.
tuberculà tus: tuberculate, with tubercles or small tubers.
tuberculô sus: tubercled, knotted.
tuberô sus: tuberous.
tubiflô rus: tube-flowered, trumpet-flowered.
tubía pathus: tube-spathed.
tubulô sus: tubulose, with tubes.
tulipíf era: tulip-bearing.
tù midus: swollen.
turbinà tus: turbinate, top-shaped.
túr gidus: turgid, inflated, full.
typhî nus: smoky or dull; perhaps pertaining to fever.
týp icus: typical, conforming to the standard or norm.

ulíc inus: like the gorse or furze (Ulex).
uliginô sus: of wet or marshy places.
ulmifô lius: Ulmus-leaved, elm-leaved.
umbellà tus: with umbels.
umbellulà tus: with umbellets.
umbonà tus: bossed, bearing at center an umbo or stout projection.
umbraculíf era: umbrella-bearing, shade-producing.
umbrô sus: shaded, shade-loving.
uncinà tus: hooked at the point.
undà tus: waved.
undecimpunctà tus: eleven-spotted.
undulatifô lius: undulate-leaved.
undulà tus: undulated, wavy.
unguiculà ris: clawed, narrowed to a petiole-like base.
unguiculà tus: unguiculate, clawed.
unguipét alus: petals clawed.
uníc olor: one-colored.
unicór nis: one-horned.
unidentà tus: one-toothed.
uniflô rus: one-flowered.
unilaterà lis: one-sided.
univittà tus: one-striped.
urceolà tus: urn-shaped.
ù rens: burning, stinging.
urentís simus: very burning, very stinging.
urophýl lus: tail-leaved.
urostà chyus: tail-spiked.
ursî nus: pertaining to bears.
urticifô lius: nettle-leaved (Urtica).
usitatís simus: most useful.
ustulà tus: burnt, sere.
ù tilis: useful.
utilís simus: most useful.
utriculà tus: utriculate, with a utricle or small bladdery one-seeded fruit.
utriculô sus: utricled.
uvíf era: grape-bearing.

và gans: wandering, vagabondish.
vaginà lis: vaginate, sheathed.
vaginà tus: sheathed.
valdivià nus, valdivién sis: Valdivian, of province of Valdivia (Chile).
valentî nus: Valentian, of Valentia (in Spain).
vâl idus: strong.
variâb ilis: variable, of many forms.
và rians: variable.
varià tus: variable.
variegà tus: variegated.
variifór mis: of variable or many forms.
và rius: various, diverse.
vastà tor (feminine *vastatrix*): ravaging, devastating.
vegetà tus: full of growth, vigorous.
vég etus: vigorous.
velà ris: pertaining to curtains or veils.
velù tinus: velvety.
venenà tus: poisonous.
venô sus: veiny.
ventricô sus: ventricose, swelling or inflated on one side or unevenly.
venús tus: handsome, charming.
verecún dus: modest, blushing.
vermiculà tus: worm-like, or like worm-tracks.
vernà lis: vernal.
vernicíf era: varnish-bearing.
vér nus: of spring, vernal.
verrucô sus: verrucose, warted.
versíc olor: variously colored.
verticillà ris: verticillate.
verticillà tus: verticillate, whorled, arranged in a circle about the stem.
vè rus: the true or genuine or standard.
vês cus: weak, thin, feeble.
vesiculô sus: with little bladders.
vesperti nus: of the evening, western.
vestî tus: covered, clothed, as with hairs or pubescence.
véx ans: puzzling, vexatious.
vexillà rius: of the standard petal (as of pea-like flowers), with a standard.
villô sus: villous, soft-hairy.
viminà lis: of osiers, of basket willows.
vimín eus: of osiers or wicker-work.
viníf era: wine-bearing.
vinô sus: full of wine.
violà ceus: violet.
violés cens: somewhat violet-colored or becoming so.
vî rens: green.
virés cens: greenish, becoming green.
virgà tus: twiggy.
virginà lis: virgin.
virgín eus: virgin.
virgín icus, virginién sis: Virginian, of Virginia.
viridiflô rus: green-flowered.
viridifô lius: green-leaved.
vír idis: green.
viridís simus: greenest, very green.
viríd ulus: greenish.
viscíd ulus: somewhat viscid.
vís cidus: viscid, sticky.
viscosís simus: very sticky.
viscô sus: viscid.
vitelli nus: dull yellow approaching red.
vitifô lius: Vitis-leaved, grape-leaved.
vittà tus: striped.
vittíg era: bearing stripes.
vivíp arus: viviparous, producing the young alive (rather than oviparous).
volgâr icus: Volgan, of the Volga river region (written also *wolgaricus*).
volù bilis: twining.
volúp tas: pleasure, delight.
volù tus: rolled-leaved.
vulgà ris: vulgar, common.
vulgà tus: common.
vulpî nus: of the fox.

wolgâr icus: Volgan (see *volgaricus*).

xanthacân thus: yellow-spined.
xán thi nus: yellow.
xanthocâr pus: yellow-fruited.
xantholeû cus: yellow-white.
xanthophýl lus: yellow-leaved.

yedoén sis: of Yedo or Yeddo (Japan).
yunnanén sis: of Province of Yun-nan, China.

zebrî nus: zebra-striped.
zeylân icus: Ceylonian, of Ceylon; Cingalese; same as *ceylanicus*.
zonà lis: zonal, zoned.
zonà tus: zoned, banded.

GLOSSARY

OF THE USUAL BOTANICAL AND HORTICULTURAL TECHNICAL WORDS

The following set of words includes many descriptive terms used in this Cyclopedia and elsewhere, with explanations of their meaning. In some respects, the Name-List (pages 148 to 159) is a glossary, and the consultant should search there when he fails to find the word in the present catalogue.

Aberrant. Unusual, or exceptional; a plant or structure that varies from customary structure or from the type; used mostly of variation.

Abortive. Defective; barren; not developed.

Abrupt. Changing suddenly rather than gradually, as a leaf that is narrowed quickly to a point, or a pinnate leaf that has no terminal leaflet; not tapering.

Acaulescent. Stemless, or apparently stemless; sometimes the stem is subterranean or protrudes only slightly.

Accessory buds. Buds more than one in an axil.

Accessory fruit. Fruit-like body composed of pericarp and other structure or structures seemingly a part of it, but not originally united with it, as wintergreen berry.

Accrescent. Increasing; becoming larger after flowering, as the calyx in some plants.

Accumbent. Lying against; said of cotyledons when the edges are placed against the radicle.

Achene (akene). A dry indehiscent one-seeded pericarp.

Achlamydeous. Lacking calyx or corolla; naked.

Acinaciform. Shaped like a scimitar; curved, round toward the point, being thicker on the outer side than on the convex or inner side.

Acotyledonous. Without cotyledons.

Adnate. Grown to, united with another part; as stamens with the corolla-tube or an anther in its whole length with the filament.

Adventitious buds. Buds appearing on occasion, rather than in regular places and order, as those arising about wounds.

Adventive. Said of an introduced plant not yet established; imperfectly or only partially naturalized.

Æstivation. The arrangement of floral envelopes in the bud (æstivus, *summer*, when flowers mostly appear. Vernation is leaf-arrangement in the bud).

Affinity. A plant or part closely related to another or much resembling it in structure.

Agglomerate. Piled together, heaped up.

Aggregate fruit. One formed by the coherence of pistils that were distinct in the flower, as blackberry.

Albumen. Starchy or other nutritive material accompanying the embryo; commonly used in the sense of endosperm, for the material surrounding the embryo.

Alburnum. The sapwood or younger wood of a tree.

Alternate. Any arrangement of leaves or other parts not opposite or whorled; placed singly at different heights on the axis or stem.

Alveolate. Honey-combed, or pitted with angular separated depressions.

Ament. Catkin.

Amentiferous. Bearing aments or catkins.

Amorphous. Formless; of no definite or constant form.

Amphigean. Of both worlds, the Old and New; said of distribution of plants.

Amphitropous. Said of a straight ovule or seed that is apparently turned a quarter way around, so that it is half inverted and with the scar or hilum on the side.

Ampullaceous. Said of plants bearing flask-like parts, as in certain aquatics such as Utricularia.

Analogous. Related in function or use, but not in origin. See *Homologous.*

Anastomosing. Netted; interveined; said of leaves marked by cross-veins forming a network.

Anatropous. Said of a straight ovule or seed that is inverted, with the micropyle next the hilum or scar.

Ander. Male; occurs in combinations as, *monandrous*, having one stamen.

Andrœceum. The male or stamen-bearing part of a flower; the stamens spoken of collectively. See *Gynœcium.*

Androphore. The cylinder or column formed by monadelphous filaments, as in the mallow and bombax tribes.

Angiosperms. Plants that bear the seeds within a pericarp, in distinction from the gymnosperms which have naked ovules and seeds; having a closed ovary.

Annual. Of one season's duration from seed to maturity and death.

Anterior. Front; on the front side; away from the axis; toward the subtending bract.

Anther. The pollen-bearing part of the stamen, borne at the top of the filament or sometimes sessile.

Antheriferous. Anther-bearing.

Anthesis. Flowering; strictly, the time of expansion of a flower, but often used to designate the flowering period; the act of flowering.

Anthocarpous. Said of a body combined of flowers and fruit united into a solid mass, as in the pineapple or the mulberry.

Anthodium. Flower-head of the Compositæ; in common speech this flower-head is erroneously called a "flower."

Antical. Front, anterior.

Apetalous. No petals; petals missing.

Apical. At the apex or top.

Apocarpus. Carpels not united; see *Syncarpous.*

Appendage. An attached subsidiary or secondary part, as a projecting part or a hanging part or supplement.

Appressed. Closely and flatly pressed against; adpressed.

Arachnoid. Cobwebby, by soft and slender entangled hairs; also spider-like.

Areole, areola. A small more or less angular space on a surface, as between network of veins.

Aril. An appendage or an outer covering of a seed, growing out from the hilum or funiculus; sometimes it appears as a pulpy covering.

Arillate. Provided with an aril.

Arillode. An aril-like structure, or false aril; a coating or covering of the seed arising from its own surface, and not from the funiculus.

Armed. Provided with any kind of strong and sharp defence, as of thorns, spines, prickles, barbs.

Articulate. Jointed; provided with nodes or joints, or places where separation may naturally take place.

Ascending. Rising up; produced somewhat obliquely or indirectly upward.

Asexual. Sexless; without sex.

Auricle. An ear-shaped part or appendage, as the projections at the base of some leaves and petals.

Awl-shaped. Narrow and sharp-pointed; gradually tapering from base to a slender or stiff point.

Awn. A bristle-like part or appendage.

Axil. Upper angle that a petiole or peduncle makes with the stem that bears it.

Axile. Borne in or on the axis, or relating to it.

Axillary. In an axil.
Axis. The main or central line of development of any plant or organ; the main stem.

Bacca. A berry.
Baccate. Berry-like; pulpy or fleshy.
Banded. Marked with cross-bars or horizontal lines of color, or with very prominent ribs or other structure.
Barb. A short point or bristle; usually employed to designate points with reflexed or fishhook-like rarely ascending appendages.
Barbulate. With fine beards.
Bark. The word is often used in a general way to designate the softer outer envelope of a stem or root. In this sense, it includes all that peels readily, as the bark of the hemlock and oak, used for tanning leather. In a stricter sense, it is applied to the corky layers formed on the outer surface of woody plants. It is formed from an active layer of tissue,—the phellogen. The bark is developed in different ways on different trees. So distinct are the resulting tissues that species of trees may be readily recognized by their bark alone. Cork of commerce is the bark of the cork oak, a native of southwestern Europe. Inasmuch as the word covers so many structures, it is little used by botanists in technical descriptions.
Bark-grafting. A kind of grafting in which the cions are inserted between the bark and wood of a stub; often, but erroneously, called crown-grafting.
Base. The bottom or lower end of a part or structure or organ, even though this part may be uppermost as the organ hangs on the plant.
Basifixed. Attached or fixed by the base, as an ovule that is affixed to its support by its bottom rather than by its side or by an angle.
Basin. The depression at the apex or blossom-end of an apple or other pome fruit.
Basinerved. All the ribs or nerves of a leaf or petal starting from its base.
Bast. The soft part of the fibro-vascular bundles in plants, abundant in the inner bark. It increases in thickness simultaneously with the wood, but much less rapidly. The fibrous elements in the bast of basswood have been used in making cordage; also in making strong paper.
Beak. A long prominent and substantial point; applied particularly to prolongations of fruits and carpels.
Beard. A long awn or bristle-like hair.
Berry. Pulpy, indehiscent, few- or many-seeded fruit; technically, the pulpy fruit resulting from a single pistil, containing one or more seeds but no true stone, as the tomato.
Bi- or Bis-. In Latin compounds, signifying *two* or *twice*.
Biauriculate, biaurite. Having two ears.
Bicallose, bicallous. Furnished with two callosities, as the lip of some orchids.
Bicrural. With two tails, legs, or slender elongations.
Biennial. Of two seasons' duration from seed to maturity and death.
Bifarious. Arranged in two rows.
Bifid. Two-cleft or two-cut.
Bifoliolate. With two leaflets to a leaf.
Biforate. With two openings, pores or apertures.
Bigener. Plant arising from a cross between two genera.
Bilabiate. Two-lipped, double-lipped.
Bilamellate. Bearing or consisting of two plates.
Bilobed. Two-lobed; parted into two lobes.
Bilocular. Two-celled; with two locules or compartments.
Bipartite. Divided into two parts; separated nearly to base.
Bipinnate. Twice-pinnate; when the primary divisions are pinnate.
Bipinnatifid. Twice-pinnatifid; when pinnatifid primary parts are pinnately cut.
Biplicate. Bearing two plaits or folds.
Biseptate. Twice-divided; with two partitions.
Biserial. In two series or sets.
Biserrate. Doubly serrate; the serratures themselves serrate.
Bisexual. Two-sexed; with both stamens and pistils.
Biternate. Twice-ternate; when the divisions of a ternate leaf are divided into three.
Bivalvular. Two-valved.
Bivittate. With two vittæ or oil-tubes.
Bladdery. Inflated; empty, and the walls thin like the bladder of an animal.
Blade. The expanded part of leaf or petal.
Blanching. A whitening or decoloring of the usually green parts of plants, as in celery or endive when it is prepared for use.
Bole. The trunk of a tree, particularly of a large tree.
Boss. A prominent center or projection on a flat and more or less circular surface.
Bottom-heat. A term used to designate the condition that arises when the roots of plants, or the soil in which they grow, are exposed to a higher temperature than that of the air in which the aërial parts are growing.
Brachiate. Branches or parts spreading at nearly right-angles and placed alternately.
Brachys. In Greek compounds, signifying *short*, as brachypodus, *on a short foot* or *stalk*.
Bract. A much-reduced leaf, particularly the small or scale-like leaves in a flower-cluster or associated with the flowers.
Bracteal. Concerning or pertaining to bracts.
Bracteole. Bractlet.
Bractlet. Bract born on a secondary axis, as on the pedicel or even on a petiole.
Breaking. Said when buds start to grow.
Bristly. Bearing stiff strong hairs or bristles.
Bud. An incipient or nascent shoot; the rudimentary or beginning state of a stem; particularly, in common speech, a thickened and condensed resting-stage of a shoot, or a flower or leaf before expanding; in propagating, a single bud used on a cutting or cion. See *Buds*, p. 586.
Budding. The operation of applying a single bud to the surface of the growing wood of the stock, with the intention that it shall grow. The bud is usually inserted underneath the bark of the cion, and is held in place by a bandage. Budding is a part of the general process of grafting. Called *inoculation* in old writings.
Bulb. A thickened part in a resting state and made up of scales or plates on a much shortened axis. See *Bulb*, p. 588.
Bulbel. A bulb arising from a mother-bulb.
Bulbiferous. Bulb-bearing.
Bulblet. Aërial bulb; a bulb borne above ground, as in the flower-cluster or a leaf-axil.
Bulbo-tuber. Corm.
Bulbous. Bulb-like; with the structure or the characteristics of a bulb.
Bullate. The surface blistered or puckered, as the leaf of a Savoy cabbage.
Bursicle. A little pouch-like or purse-like receptacle.
Bush. A low and thick shrub, without distinct trunk.

Caducous. Falling off early, or prematurely, as the sepals in some plants.
Calcarate. Spurred.
Calcariform. Spur-formed; shaped like a calcar or spur.
Calceolate. Slipper-like; having the form of a rounding toed shoe.
Callosity. A thickened and hardened part or protuberance.
Callus. A hard prominence or protuberance; in a cutting or on a severed or injured part, the roll of new covering tissue.
Calycine. Pertaining to a calyx, or calyx-like.
Calyculate. Calyx-like; bearing a part resembling a calyx; particularly, furnished with bracts against or underneath the calyx resembling a supplementary or outer calyx.
Calyptra. A hood or lid; particularly the hood or cap of the capsule of a moss.
Calyptriform. Hood-formed; like a cap pulled over.

Calyx. The outer circle of floral envelopes.

Cambium. The growing or nascent tissue lying between the xylem and phloem of the fibro-vascular bundle, and therefore on the outside of the woody trunk between wood and bast, or in trees and shrubs between wood and "bark." Its function is to increase the stem in diameter.

Campanulate. Bell-shaped.

Campylotropous. Said of an ovule or seed so curved or turned on itself as to bring the apex and base together.

Canaliculate. Grooved or channeled lengthwise.

Canescent. Gray-pubescent and hoary.

Cap. A convex removable covering of a part, as of a capsule; in the grape, the cohering petals fall off as a cap.

Capillary. Hair-like; very slender.

Capitate. Headed; in heads; formed like a head; aggregated into a very dense or compact cluster.

Capitulum. Head; a close body of sessile flowers.

Capsular. Pertaining to a capsule; formed like a capsule.

Capsule. Compound pod; a dry fruit of more than one carpel, opening at maturity.

Carinate. Keeled; provided with a projecting central longitudinal line or ridge on the lower or under surface.

Carpel. One of the foliar units of a compound pistil; a simple pistil contains one carpel.

Carpophore. Fruit-stalk; stem bearing the carpels; particularly, in the Umbelliferæ, the slender extended axis that supports the ripe seed-like carpels.

Cartilaginous. Hard and tough, like parchment.

Caruncle. On a seed, a protuberance .or growth at or around the hilum.

Caryopsis. An achene-like fruit, with the thin pericarp or covering grown fast to the seed; it is the characteristic fruit of the cereal grains and other grasses.

Cataphyll. An undeveloped leaf, as at the beginning of a growth.

Catkin. A scaly-bracted spike with declinous flowers; ament; prominent in willows and poplars.

Caudex. Stem, trunk; used particularly to designate the persistent base of an herbaceous stem that is otherwise annual, and also for the stem of tree-ferns and palms.

Caudicle. Little stem, stemlet; stalk of pollinium in orchids.

Caulescent. More or less stemmed or stem-bearing; having an evident stem above ground.

Caulicle. Stemlet of the embryo; radicle.

Cauline. Pertaining or belonging to the stem.

Cavity. The depression at the bottom or stem-end of an apple or similar fruit.

Cell. One of the ultimate compartments or vesicles of which plants are composed or made up; also, a cavity or compartment or locule of an ovary or anther.

Cellular. Tissue made up of short thin-walled cells, rather than of fibers or tubes.

Centrifugal. Away from the center.

Centripetal. Toward the center.

Centrum. The central part of any structure; particularly the large central air-space in hollow stems.

Cephalanthium. An old name for the flower-head of composites; anthodium.

Cephalium. The head-like stem-end of condensed cacti, bearing the flowers and fruits.

Cernuous. Drooping; inclining somewhat from the perpendicular.

Cespitose. Matted; growing in tufts; in little dense clumps; said of low plants that make tufts or turf of their basal growths.

Chæta. A bristle; seta.

Chaff. A small thin dry and membranous scale or bract; in particular, the bracts in the flower-heads of composites.

Channeled. Deeply grooved lengthwise; canaliculate.

Chartaceous. Thin, hard and stiff; having the texture of writing-paper.

Chrysos. In Greek compounds, signifying *golden* or *golden yellow.*

Ciliate. Fringed with hairs; bearing hairs on the margin.

Ciliolate. Slightly or minutely ciliate.

Cinereous. Ash-colored; light gray.

Cinnamomeus. Cinnamon-colored.

Cion. The bud or branch used in grafting; also spelled *scion.*

Circinate. Coiled downward or inward from the top, as the young frond of a fern and cycas.

Circumscissile. Opening or dehiscing by a line around the fruit or anther, the valve usually coming off as a lid.

Cirrhiferous. Tendril-bearing.

Cirrhiform. Tendril-form.

Cirrhus, cirrus. A tendril.

Cladophyllum. A flattened leaf-like branch, functioning as foliage, as in many acacias and in asparagus.

Clados. In Greek compounds, signifying a *branch.*

Clasping. Leaf partly or wholly surrounding stem.

Clavate. Club-shaped; said of a long body thickened toward the top.

Claw. The long narrow petiole-like base of the petals or sepals in some flowers.

Cleistogamous flowers. Small closed self-fertilized flowers, as in some violets and in many other plants.

Close fertilization. Fecundation by pollen from same flower; self-fertilization.

Clove. One of the separable parts of a composite bulb, as of the garlic.

Clypeate. With the form of an ancient buckler or round convex shield; shield-like.

Coalescence. The union of similar parts or organs, or of those in the same series as stamens with stamens and petals with petals.

Coarctate. Crowded together.

Coccus. A berry (plural *cocci*); in particular, one of the parts of a lobed fruit with one-seeded cells.

Cochleariform. Spoon-shaped.

Coherent. Two or more similar parts or organs joined.

Cohesion. The union of two or more organs of same kind.

Collateral. By the side; standing side by side.

Column. Body formed of union of stamens and pistil in orchids, or of stamens, as in mallows.

Commissure. The place of joining or meeting; as the face by which one carpel joins another.

Comose. Bearing a tuft or tufts of hair.

Complete flower. All parts present.

Complete leaf. Having blade, petiole, stipules.

Complicate. Folded over or back on itself.

Compound. Of two or more similar parts in one organ.

Compound leaf. A leaf with two or more separate leaflets; in some cases (as in Citrus) some of the leaflets may be obsolete and the compound leaf have only one leaflet.

Compound pistil. Of two or more carpels united.

Compressed. Flattened, especially flattened laterally.

Conchiform. Shell-form; like one valve of a bivalve shell.

Conduplicate. Two parts folded together lengthwise.

Cone. A dense and usually elongated collection of flowers or fruits borne beneath scales, the whole with scales and axis forming a detachable homogeneous fruit-like body; some cones are of short duration, as the staminate cones of pines, and others become dry and woody durable parts .

Confluent. Running together so as to form a single part or organ; blended.

Conformed. Of the same form or character as something else or as a related part or structure.

Congested. Crowded very closely together; collected into a mass or body.

Conglobate. Gathered into a ball or globe.

Conglomerate. Clustered; brought together.

Coniferous. Cone-bearing.

Connate. United or joined; in particular, like or similar structures joined as one body or organ.

Connective. The filament or tissue connecting the two cells of an anther, particularly when the cells are separated.

Connivent. Coming together or converging, but not organically connected.
Conoidal. Cone-like; nearly conical.
Convolute. Said of floral envelopes in the bud when one edge overlaps the next part or petal or sepal or lobe while the other edge or margin is overlapped by a preceding part; rolled up.
Cordate. Heart-shaped; with a sinus and rounded lobes at the base and ovate in general outline.
Cork. The name applied to the outer impervious mostly not-living part of the bark. Most bark develops a corky exterior, and in some cases it becomes very prominent. In *Evonymous Thunbergianus*, the English maple, the corky barked elm, and other trees and shrubs, it forms wings on the branches. The cork of commerce comes from the bark of *Quercus Ilex* (better known as *Q. Suber*), plantations of which grow in southwestern Europe. The cork tree of the catalogues, *Phellodendron amurense*, is a curious tree, cultivated for ornament.
Corm. A solid bulb-like part, usually subterranean, as the "bulb" of crocus and gladiolus.
Cormel. A corm arising from a mother-corm.
Cormlet. Aërial corm, or one borne in the inflorescence or in the leaf axils.
Cormous. With corms, or pertaining to corms.
Corneous. Horny; hard and very dense in texture.
Corniculate. Bearing or terminating in a small horn-like protuberance or process.
Corolla. Inner circle of floral envelopes; if the parts are separate, they are petals; if not separate, they are teeth, lobes or divisions.
Corona. Crown, coronet; any appendage or intrusion that stands between the corolla and stamens, or on the corolla, as the cup of a daffodil, or that is the outgrowth of the staminal part or circle, as in the milkweeds.
Coroniform. Crown-formed or crown-like; corona-like.
Corticate. Having a cortex or hard bark; also having a rind, as the lemon and orange.
Corymb. Short and broad, more or less flat-topped indeterminate flower-cluster.
Corymbose inflorescence. Outer flowers opening first.
Costa. A rib; in particular a strong rib or line, as a midrib or mid-nerve.
Costate. Ribbed.
Cotyledon. Seed-leaf; the primary leaf or leaves in the embryo; in some plants the cotyledon always remains in the seed-coats and in others (as bean) it emerges on germination.
Crateriform. Deep saucer-shaped; cup-shaped.
Creeper. A trailing shoot that takes root in the ground throughout its length.
Crenate. Shallowly round-toothed or obtusely toothed.
Crenulate. Finely or shallowly crenate.
Crested. With elevated and irregular or toothed ridge.
Cribrose. Sieve-like; with numerous small apertures.
Crop. Produce of tilled, cared-for or protected plants.
Croppage. The whole subject of the producing of crops.
Cross. The offspring of any two flowers that have been fertilized. A cross-breed is a cross between varieties of the same species. Synonyms are half-breed, mongrel, variety-hybrid. Crossing is the operation of cross-pollinating. Cross-pollination is the transfer of the pollen of one flower to the pistil of another.
Cross-fertilization. Fertilization or fecundation secured by pollen from another flower.
Cross-pollination. Transfer of pollen from flower to flower.
Crown. Corona; also that part of the stem at the surface of the ground; also a part of a rhizome with a large bud, suitable for use in propagation.
Cruciate. Cross-shaped or cross-like.
Crustaceous. Said of bodies or coverings that are hard and brittle.
Cryptogam. Flowerless plant, as fern, moss, fungus, seaweed; less used than formerly as a technical term.
Cryptos. In Greek compounds, signifying *concealed.*
Culm. The stem of sedges and grasses, and similar plants.
Cuneate. Wedge-shaped; triangular, with the narrow end at point of attachment, as of leaves or petals.
Cupular. Cup-like or cup-shaped; the acorn nut sits in a cupule or little cup (whence the name Cupuliferæ).
Cuticle. The external rind or skin of a plant or part; usually applied to the thin waterproof membrane overlying the epidermis.
Cutting. A severed vegetative or asexual part of a plant used in propagation; as a cutting of root, of stem, or of leaf.
Cyathiform. Cup-shaped.
Cymbiform. Boat-shaped.
Cyme. A broad, more or less flat-topped determinate flower-cluster.
Cymose inflorescence. With central flowers opening first.
Cypsela. An old term for the fruit of composites, being dry, one-celled and one-seeded.

Deciduous. Falling, as the leaves of non-evergreen trees.
Decompound. More than once compound.
Decumbent. Reclining or lying on the ground, but with the end ascending.
Decurrent. Running down the stem, as the leaf of mullein.
Decussate. Opposite leaves in four rows up and down the stem; alternating in pairs at right angles.
Definite. Said of a constant or known number, not exceeding twenty; contrasted with indefinite, above twenty, when the parts are usually not counted in systematic descriptions.
Deflexed. Turned downward abruptly.
Defoliation. The casting or falling of the leaves.
Dehiscence. The method or process of opening of a seed-pod or anther.
Deliquescent. Trunk or leader lost in the branches; said of tree-top without a leader.
Deltoid. Triangular; delta-like.
Dendroid. Said of tree-shaped small plants.
Dendron. In Greek compounds, signifying a *tree.*
Dentate. With sharp spreading teeth.
Depauperate. Applied to a plant or part that is less perfectly developed than usual or normal; also said of very small members of a genus or family.
Depressed. More or less flattened endwise or from above.
Descending. The direction gradually downwards.
Determinate. Definite cessation of growth at the apex or in the main axis.
Di-, Dis,-. In Greek combinations, signifying *two* or *twice* as diphyllus, *two-leaved.*
Diadelphous. In two groups, as the stamens of some Leguminosæ, joined by their filaments.
Diandrous. With two stamens.
Diaphanous. Transparent or translucent.
Dicarpellous. Comprised of two carpels.
Dichlamydeous. Provided with both calyx and corolla.
Dichogamy. Stamens and pistils maturing at different times.
Diclinous. Imperfect; having either stamens or pistils but not both; unisexual. See *Monoclinous.*
Dicoccous. Separating into two cocci.
Dicotyledonous. With two cotyledons.
Didynamous. With four stamens in two pairs of different length.
Diffuse. Loosely branching or spreading; of open growth.
Digitate. Hand-like; compound with the members arising from one point.
Dimerous. The parts in twos.
Dioecious. Staminate and pistillate flowers on different plants.
Dipterous. Two-winged.
Dipyrenous. Having two stones or pyrenes.
Disciform. Flattish and circular like a discus.
Discoid. Disk-like; in particular, said of a head of Compositæ without ray-flowers.

Disk, disc. A more or less fleshy or elevated development of the receptacle about the pistil; receptacle in the head of Compositæ.
Disk-flowers. The tubular flowers in the center of heads of Compositæ, as distinguished from the ray-flowers.
Dissected. Divided into many slender segments.
Dissepiment. A partition, particularly in an ovary or fruit.
Distinct. Separate; not united with parts in the same series.
Divided. Separated to the base.
Division. Propagation by means of separating the root system or rhizome system into parts; cutting up the plant into several root-bearing parts or pieces, as when one rhubarb plant is made into two or more.
Dorsal. Back; relating to the back or outer surface of a part or organ.
Dorsiferous. Bearing anything on the back.
Dorsifixed. Attached by the back.
Dorsoventral. Literally, back-front; placed with reference to the back or front or to both.
Double. Said of flowers that have more than the usual number of floral envelopes, particularly of petals; full.
Downy. Covered with very short and weak soft hairs.
Drupe. A fleshy one-seeded indehiscent fruit, with seed inclosed in a stony endocarp; stone-fruit.
Drupelet. One drupe in a fruit made up of aggregate drupes, as in the raspberry.
Dumose. Low and branching, as a bush.

E- or Ex-. In Latin-formed words, usually denoting, as a prefix, that parts are missing, as exstipulate, *without stipules*, estriate, *without stripes*.
Ecalcarate. Without calcar or spur.
Ecology. Study of habits and modes of life of animals and plants.
Ecostate. Without ribs.
Edentate. Without teeth.
Effuse. Loosely spreading; very diffuse.
Eglandulose. Without glands.
Elliptic. A flat part or body that is oval and narrowed to rounded ends.
Elongate. Lengthened; stretched out.
Embryo. The plantlet in the seed.
Endocarp. The inner layer or part of a pericarp.
Endogen. Term applied to stems having scattered bundles, as of Indian corn, not appropriate, and now little used. See *Exogen*.
Endosperm. Starch or other food outside or around the embryo; albumen.
Ensiform, ensate. Sword-shaped; long, flat, 2-edged, nearly or quite straight, with a sharp point.
Entire. Margin not in any way indented; whole.
Environment. Surroundings; conditions in which organisms live and grow.
Ephemeral. Persisting for one day only, as flowers of spiderwort.
Epi. A Greek prefix signifying *on* or *upon*.
Epicarp. The outer layer or surface of the pericarp.
Epichile. The upper part of the jointed lip of an orchid.
Epicotyl. That part of the caulicle lying above the cotyledons.
Epidermis. Superficial layer of cells and underneath the cuticle.
Epigeal. Cotyledons rising into the air in germination.
Epigeous. Close upon the ground rather than underneath.
Epigynous. Borne on the ovary; used of floral parts when ovary is inferior and flower not perigynous.
Epipetalous. On a petal.
Epiphyllous. On a leaf.
Epiphyte. Air-plant; a plant growing on another or on some other elevated support.
Equitant. Sitting astride; used for conduplicate leaves that stand inside each other in two ranks, as in Iris.
Erostrate. Without a beak.
Essential organs. Stamens and pistils.
Evergreen. Remaining green throughout the year.
Exalbuminous. Seeds without albumen or endosperm.
Excentric. Out of or away from the center.
Excurrent. The trunk or leader continuing through the top.
Exfoliating. Coming off in thin layers, as the bark of birch and other plants.
Exocarp. The outside part of a pericarp.
Exogen, exogenous. Growing and increasing in diameter by layers on the exterior of the woody cylinder, in distinction from endogens.
Exserted. Sticking out; projecting beyond, as stamens from a perianth.
Exsiccated. Dry or dried.
Exstipulate. Without stipules.
Extrorse. Looking or facing outward.
Eye. The marked center of a flower; a bud on a tuber, as on a potato; a single-bud cutting.

Facies. The general appearance or "looks" of a plant; or the characteristic appearance of a plant society.
Farinaceous. Containing starch, or starch-like materials.
Fasciated. Much flattened; an abnormal or teratological widening and flattening of the stem.
Fascicle. A condensed or close cluster, as of flowers.
Feminine. Pistillate (in higher plants).
Fertile. Said of pollen-bearing stamens and seed-bearing fruits.
Fertilization. Impregnation of the ovule; the act of union of sperm and egg cells, in the higher plants taking place within the ovule: fecundation.
Fetid. Having a disagreeable odor.
Fibrillose. With fine fibers or threads.
Fibrous. Fiber-like; containing fibers or thread-like parts.
Fibro-vascular. Made up of both fibers and ducts; combination of fibrous and vascular structure.
Filament. Stalk of the anther.
Filiform. Thread-like; long and very slender.
Fimbriate. Fringed.
Fimbrillate. Minutely fringed.
Fistular. Cylindrical and hollow.
Flaccid. Soft; lax and weak; not rigid.
Flagelliform. Whip-form; long and slender like a lash.
Flagging. Wilting; said particularly of newly made cuttings and recently transplanted plants.
Flexuous. Having a more or less zigzag or wavy form; said of stems of various kinds.
Floccose. With tufts or flocks of soft wool or woolly hair.
Flora. The plant population of a given region; also a book describing this population.
Florets. Individual flowers of composites and grasses; also other very small flowers that make up a very dense form of inflorescence.
Floriferous. Flower-bearing.
Foliaceous. Leaf-like; said particularly of sepals and calyx-lobes and of bracts that in texture, size or color look like small or large leaves.
-foliate. In combinations, -leaved; having leaves; as trifoliate, *three-leaved*.
-foliolate. Having leaflets; as trifoliolate, *of three leaflets*.
Follicle. Dry, dehiscent pericarp opening only on the front suture.
Follicular. With follicles; follicle-like.
Foramen. An aperture or opening.
Forked. Branching or divided into nearly equal parts or members.
Fornicate. Arched.
Free. Not joined to other organs; as petals free from the stamens or calyx.
Frond. Leaf of fern; sometimes used in the sense of foliage.
Frosted. With a more or less shining or crystallized white covering.
Fructification. The act or process of fruiting; also the fruiting organ or organs.
Fruit. The ripened pericarp or pericarps with the adnate parts; the seed-bearing organ.
Fruticose. Shrubby or shrub-like in the sense of being woody.

Fugacious. Falling or withering away very early.
Fumose. Smoke-colored.
Function. What a plant or a part does; its vital activities.
Funicle. The stalk or stipe of an ovule or seed.
Funnelform. With tube gradually widening upward and passing insensibly into the limb, as in many flowers of Convolvulus; infundibuliform.
Furrowed. With longitudinal channels or grooves.
Fusiform. Spindle-shaped; narrowed both ways from a swollen middle, as dahlia roots.

Galea. A hood or a helmet-shaped part or structure, as found in the upper lip of some corollas.
Gamete. One of the sex-cells, either male or female.
Gamopetalous. Corolla of one piece; petals united.
Gamophyllous. Leaves united.
Gamosepalous. Calyx of one piece; sepals united.
Geminate. In pairs; twin.
Gemma. A bud; particularly a bud or bud-like structure by which a plant propagates.
Gemmiparous. Bud-bearing.
Gemmule. A little bud or bud-like structure.
Generation. Period from birth (impregnation) to death; the epoch from one 1-celled stage of a plant to the next 1-celled stage.
Germination. The unfolding of the embryo and becoming self-established of the plantlet.
Gibbosity. A swelling or bulging on one side or near the base.
Glabrate. Nearly glabrous, or becoming glabrous with maturity or age.
Glabrous. Not hairy.
Gladiate. Sword-shaped or sword-like.
Gland. Properly a secreting part or prominence or appendage, but often used in the sense of gland-like.
Glandular. Having or bearing secreting organs, or glands.
Glandulose, glanduliferous. Gland-bearing.
Glaucous. Covered with a "bloom" or a whitish substance that rubs off.
Glochidiate. Said of parts with summit barbed.
Glomerate. In dense or compact cluster or clusters.
Glomerule. Dense head-like clusters; properly a dense cyme.
Glume. A small chaff-like bract; in particular, one of the two empty bracts at the base of the grass spikelet.
Graft. A branch or bud inserted on another plant with the intention that it shall grow there; cion.
Grafting. The process of inserting a cion in a plant with the intention that it shall grow there. See *Budding.*
Granular, granulose. Covered with very small grains; minutely or finely mealy.
Gymnos. In Greek compounds, signifying *naked* or *not covered:* as gymnosperms, *with naked seeds* (not in a pericarp). See *Angiosperm.*
Gynandrous. With the stamens grown on the pistil, forming one organ, as in the orchids.
Gynobase. Stipe or stalk of an ovary, being an extension or prolongation of the receptacle; short gynophore.
Gynæcium. The female or pistil-bearing part of the flower. See *Andrœcium.*
Gynophore. Stipe of an ovary prolonged within the calyx.

Habit. The looks, appearance, general style or mode of growth; as an upright, open, decumbent or strict habit.
Habitat. Particular place in which a plant grows; as a swamp, roadside, lawn, woods, ballast-heap, hillside.
Hairs. A general name for many kinds of small and slender outgrowths on the parts of plants; special kinds of hairiness are designated as setose, villous, comose, pubescent, hirsute, and others.
Halberd-shaped. Hastate.
Hamate. Hooked.
Hastate. Of the shape of an arrow-head but the basal lobes pointed or narrow and standing nearly or quite at right angles; halberd-shaped.
Haulm. Straw-like stems, as of the cereal grains; sometimes also applied to the stems of palms; usually a collective noun.
Head. A short dense spike; capitulum.
Heart-shaped. Cordate; ovate in general outline but with two rounded basal lobes; has reference particularly to the shape of the base of a leaf or other expanded part.
Heel. An enlarged or more or less transverse part on the lower end of a cutting secured from the older or larger branch from which the cutting is taken.
Helicoid. Twisted or coiled in snail-shell form.
Heliotropism. The characteristic of turning toward the light.
Hemi- In Greek compounds, signifying *half.*
Hepta- In Greek compounds, signifying *seven.*
Herb. Naturally dying to the ground; without persistent stem above ground; lacking definite woody firm structure.
Herbaceous. Not woody; dying down each year; said also of soft branches before they become woody.
Hermaphrodite. Bearing both stamens and pistil in the same flower; two-sexed; bisexual.
Hesperidium. The fruit of the orange-kind.
Heterocarpous. Various-fruited; with more than one kind or form of fruit.
Heterogamous. With two or more kinds or forms of flowers.
Heteros. In Greek composition, signifying *various,* or of *more than one kind* or *form;* as heterophyllous, *with more than one kind* or *form of leaf.*
Hilum. In the seed, the scar or mark indicating the point of attachment.
Hip. Fruit of the rose, being an urn-like or closed receptacle bearing the achenes inside. See *Hypanthium.*
Hirsute. With rather rough or coarse hairs.
Hirtellous. Softly or minutely hirsute or hairy.
Hispid. Provided with stiff or bristly hairs.
Hispidulous. Somewhat or minutely hispid.
Hoary. Covered with a close white or whitish pubescence.
Homo- In Greek compounds, signifying *alike* or *very similar.*
Homocarpous. All the fruits, as of a flower-head, alike.
Homogamous. Presenting only one kind of flowers.
Homologous. Related in origin or morphology. See *Analogous.*
Homomorphous. Uniform; all the given parts alike.
Horny. Hard and dense in texture; corneous.
Hybrid. A plant resulting from a cross between two or more parents that are more or less unlike.
Hygroscopic. Capable of absorbing moisture from atmosphere.
Hypanthium. A fruit-like body (as the rose-hip) formed by the enlargement of the torus and bearing the proper fruits on its upper or inner surface; literally "beneath the flower." Now commonly used to denote the cup-shaped receptacle on which calyx, petals and stamens are inserted in cases of perigyny, as in plum, fuchsia.
Hypochil. The lower or basal part of the lip in orchids.
Hypocotyl. That part of the caulicle lying below the cotyledons.
Hypocrateriform. Salver-form; that shape of the flower characterized by a cylindrical tube and a flat-spreading limb, as in phlox.
Hypogeal. Cotyledons remaining beneath the ground in germination.
Hypogynous. Borne on the torus, or under the ovary; said of the stamens or petals.

Immarginate. Without a rim or edge.
Immersed. Entirely under water.
Imparipinnate. Unequally pinnate; odd-pinnate; with a single terminal leaflet.
Imperfect flower. Having either stamens or pistils, but not both.
Implexed, implexuous. Entangled, interlaced.
Impregnation. Fecundation or fertilization of the ovule by the pollen; also, the infiltration of substances.

Impressed. Deeply nerved; furrowed or grooved as if by pressure.
Inarching. The grafting together of two plants with the intention that, when they are severed, part of one plant will be growing on the other.
Incanescent. Hoary- or gray-pubescent; canescent.
Incised. Cut; slashed irregularly, more or less deeply and sharply.
Inclining. Looking or falling down from the horizontal.
Included. Not protruded, as stamens not projecting from the corolla.
Incomplete. Lacking some of its parts, as a flower deficient in stamens or calyx.
Incrustate. Crusted; with a hard or firm covering.
Incumbent (cotyledons). Of a seed so bent over that the back of one cotyledon lies against the radicle.
Indefinite. Very numerous, as above twenty; see *Definite.*
Indehiscent. Not regularly opening, as a seed-pod or anther.
Indeterminate. Growing on from the apex, particularly of the main axis.
Indigenous. Native to the region; not introduced from some other country.
Indumentum. A covering of hair.
Induplicate. With margins folded inward.
Indurated. Hard, hardened.
Indusium. The little growth covering or surrounding the sorus or fruit-dot in ferns.
Inferior. Beneath, lower, below; as an inferior ovary, one that is below the calyx-leaves.
Inflated. Blown up; bladdery.
Inflorescence. Mode of flower-bearing; technically less correct but much more common in the sense of a flower-cluster.
Infra- In combinations, signifying *below.*
Infundibuliform. Funnelform.
Innate. Said of an anther when attached by its base to the filament.
Innovation. An offshoot or departure from the axis.
Inserted. Attached; as a stamen growing on the corolla.
Inter-. In composition, signifying *between,* particularly between closely related parts or organs.
Interfoliaceous. Between the leaves, particularly between two leaves of a pair.
Internode. The part or space of stem between two nodes or joints.
Interrupted. Not continuous; in particular, the interposition of small leaflets or segments between others.
Intorted. Twisted upon or around itself.
Intramarginal. Just within the margin or edge; between the margins.
Introduced. Brought from another region, either intentionally or otherwise; in horticulture, used to designate the intentional bringing of plants into cultivation either from another country or from the wild.
Introrse. Turned or faced inward or toward the axis, as an anther looking toward the center of the flower.
Inverted. Turned over; end-for-end; top-side down.
Involucel. A secondary involucre; small involucre about the parts of a cluster.
Involucre. A whorl of small leaves or bracts standing close underneath a flower or flower-cluster.
Involute. Said of a flat body (as a leaf) rolled inward or toward the upper side. See *Revolute.*
Irregular flower. Some parts different from other parts in same series.

Jointed. With nodes, or points of real or apparent articulation.

Keeled. Ridged like the bottom of a boat; also the two front united petals of a papilionaceous flower.
Knaur. An excrescence, bur or knot of woody tissue that will grow when removed and used as a cutting.

Labellum. Lip, particularly the lip of orchids.
Labiate. Lipped; a member of the Labiatæ.
Labyrinthiform. With intricate winding lines or passages.
Lacerate. Torn; irregularly cleft or cut.
Laciniate. Slashed into narrow pointed lobes.
Lactescent. Containing milk or a milk-like substance.
Lacunose. Having holes or empty places, particularly in the anatomical structure.
Lamella. A thin flat plate or part.
Lamina. The blade of a leaf or petal or other expanded part or body.
Lanceolate. Lance-shaped; much longer than broad; widening above the base and tapering to the apex.
Lapidose. Found in stony places.
Lateral. On or at the side.
Layer. A branch that takes root and gives rise to an independent plant.
Leaflet. One part of a compound leaf; secondary leaf.
Leaf-stalk. The stem of a leaf; petiole; foot-stalk.
Legume. Simple pericarp dehiscing on both sutures; pod.
Lemma. In grasses, the flowering glume,—the lower of the two bracts immediately inclosing the flower.
Lenticular. Lentil-shaped; lens-shaped.
Lepals. Sterile stamens, particularly those nectaries or scales representing stamens; term little used.
Lepidote. Surfaced with small scurfy scales.
Liana, liane. A woody twining or climbing plant entangling a tropical forest.
Life-history. The sum of the events in the life of a plant.
Ligneous. Woody.
Ligule. A strap-shaped organ or body; particularly, a strap-shaped corolla, as in the ray-flowers of composites; also a projection from the top of the sheath in grasses and similar plants.
Limb. The expanded flat part of an organ; in particular, the expanding part of a gamopetalous corolla.
Limbate. Surrounded by an edging of another color; margined with color; also, provided with a limb.
Line. One-twelfth of an inch.
Linear. Long and narrow, the sides parallel or nearly so.
Lineate. Lined; bearing thin parallel lines.
Linguiform. Shaped like a lingula, or with a projecting tongue-like part or process.
Lip. One of the parts in an unequally divided corolla or calyx; these parts are usually two, the upper lip and the lower lip, although one lip is sometimes wanting; the upper lip of orchids is by a twist of the stipe made to appear as the lower; a labium.
Lobe. Any part or segment of an organ; specifically a part of petal or calyx or leaf that represents a division to about the middle.
Lobule. A small lobe.
Locule. Compartment or cell of a pistil or anther.
Loculicidal. Dehiscence between the partitions into the cavity.
Lodicule. A small scale in a grass flower, between the lemma and stamens.
Loment. A legume with constrictions or articulations.
Lorate. Strap-shaped.
Lyrate. Pinnatifid but with an enlarged terminal lobe and smaller lower lobes.

Medullary. Relating to the pith; the medullary rays seen in cross-sections of woody trunks radiate from the medulla or pith.
Meniscoidal. Like a meniscus or disk; with the form of a watch-crystal.
Mericarp. The peculiar seed-like fruit of the Umbelliferæ.
-merous. In composition, referring to the numbers of parts; as flowers 5-merous, in which the parts of each kind or series are five or in fives.
Mesocarp. Middle layer or part of a pericarp; the part between the endocarp and exocarp.
Mesochil. The intermediate or middle part of the lip of orchids when the lip is separated into three parts.
Micropyle. The opening through which impregnation takes place; the point on the seed marking the orifice of the ovule.

Midrib. The main rib of a leaf or leaf-like part.
Mitriform. Mitre-shaped, or like a cap.
Monadelphous. Stamens united in one group by their filaments as in many Leguminosæ.
Moniliform. Suggesting a string of beads.
Mono-. In Greek compounds, signifying *one.*
Monoclinous. Hermaphrodite; perfect; the two sexes in the same flower. See *Diclinous.*
Monocotyledonous. With a single cotyledon.
Monœcious. Staminate and pistillate flowers on the same plant.
Monogynous. With only one style.
Monopetalous. One-petaled; all the petals united to form one body or organ, as a gamopetalous corolla.
Monopodial. Axial direction continued by growth from terminal bud or persistance of the leader.
Monostichous. In one row.
Monstrosity. Deformity; any unusual or non-typical kind of development.
Morphology. The science or subject that treats of forms or of the transformations of organs.
Mucose. With a slimy covering or secretion.
Mucro. A short and sharp abrupt tip.
Mule. An old word for a cross, particularly between different species; hybrid; cross-breed.
Multifid. Cut or cleft into many narrow lobes or parts.
Multiple. Of several or many distinct parts.
Multiple fruit. The united product (in one body) of several or many flowers.
Multiseptate. With many divisions or chambers, as some nuts.
Muscariform. In form of a brush or fly-brush.
Mycelium. Vegetative part of a fungus, composed of threads or thready tissue.

Naked flower. With no floral envelopes; without calyx and corolla.
Napiform. Turnip-shaped; more or less short-fusiform; broader than high and abruptly tapering both ways.
Navicular. Boat-shaped; cymbiform.
Nectariferous. Nectar-bearing.
Nectary. A structure or organ that secretes nectar.
Nephroid. Kidney-shaped; reniform.
Nerve. A vein or slender rib, particularly if not branched.
Netted. Marked with reticulated lines or nerves that project somewhat above the surface.
Neuter, neutral. Neither stamens nor pistils; sexless.
Nidulate. Nested; as if like or borne in a nidus or nest.
Node. A joint where a leaf is borne or may be borne; also incorrectly the space between two joints, which is properly an internode.
Nucleus. The kernel of a seed; the central denser structure of a cell.
Nucule. A small nutlet; any hard seed-like fruit or part.
Nut. An indehiscent 1-celled and 1-seeded hard and bony fruit, even if resulting from a compound ovary.
Nutlet. A small or diminutive nut; nucule.

Ob-. A Latin syllable, usually signifying inversion.
Obconical. Inversely conical; cone attached at the small point.
Oblanceolate. Inversely lanceolate; with the broadest part of a lanceolate body away from the point of attachment.
Oblique. Slanting; unequal-sided.
Oblong. Longer than broad, and with the sides nearly or quite parallel most of their length.
Obovate. Inverted ovate.
Obovoid. An ovoid body attached at the smaller end.
Obsolescent. Nearly obsolete; becoming rudimentary.
Obsolete. Not evident or apparent; rudimentary.
Obtuse. Blunt, rounded.
Ocellated. Eyed; a circular spot of one color inside a larger spot or area of another color.
Ochraceous. Ochre-yellow, gradually changing to brown.
Ocrea. A boot-shaped or tubular stipule, as in Polygonum.
Oculus. An eye; a leaf-bud when used as a cutting.
Offset. A plant arising close to the base of mother plant.
Oleaginous. Fleshy and oily.
Oligos. In Greek compounds, signifying *few.*
Opaque. Dull; not translucent or shining.
Operculum. A lid, as of a circumscissile capsule.
Orthos. In Greek compounds, signifying *straight.*
Orthotropous (ovule or seed). An erect straight seed, with the micropyle at the apex and hilum at the base.
Osseous. Bony, hard, brittle; of very close texture.
Ovary. Ovule-bearing part of a pistil.
Ovate. With an outline like that of hen's egg cut in two lengthwise, the broader end downward.
Ovoid. A solid that is oval in outline.
Ovule. The body which, after fertilization, becomes the seed.
Ovuliferous. Ovule-bearing.

Painted. Said of colors that are in streaks of unequal brilliancy.
Palate. In personate corollas, a rounded projection or prominence of the lower lip, closing the throat or very nearly so.
Palea, palet. In the grass flower, the upper of the two inclosing bracts, the lower one being the lemma.
Palmate. Lobed or divided in a palm-like or hand-like fashion.
Palmatifid. Cut about half way down in a palmate form.
Panicle. A branching raceme; flower-cluster in which the branches are racemose, the flowers being pedicellate.
Papilionaceous corolla. Butterfly-like; pea-like flower, with a standard, wings, and keel.
Pappiform. Pappus-like.
Pappus. Peculiar calyx-limb of composites, being plumose, bristle-like, scales, or otherwise.
Parasitic. Growing and living on or in another organism.
Parietal. Borne on the paries or wall (inner surface) of a capsule.
Parted. Cleft or cut not quite to the base.
Parthenogenetic. Seed developing without fertilization or fecundation.
Partial. Of secondary importance or rank.
Partite. Divided very nearly to the base.
Partitioned. Divided in compartments or chambers by internal horizontal partitions.
Pathological. Diseased.
Pedicel. Stem of one flower in a cluster.
Peduncle. Stem of a flower-cluster or of a solitary flower.
Pellucid. Clear, transparent; that can nearly be seen through.
Peltate. Attached to its stalk inside the margin; peltate leaves are usually shield-shaped.
Penninerved. Nerves arising along the length of a central midrib.
Pentamerous. In fives.
Pepo. Fruit of pumpkin, squash, and the like.
Perennial. Of three or more seasons' duration.
Perfect flower. One that has both stamens and pistil.
Perfoliate. The stem apparently passing through the part, as a leaf; united around the stem.
Pergameneous, pergamentaceous. Texture of parchment.
Peri-. In Greek compounds, signifying *around.*
Perianth. The floral envelope considered together; commonly used for flowers in which there is usually no clear distinction between calyx and corolla, as the lilies.
Pericarp. The ripened ovary.
Perigynium. The sac or utricle that incloses the ovary or achene in Carex; it is sometimes inflated.
Perigynous. Borne around the ovary and not beneath it, as when calyx, corolla and stamens are borne on the edge of a cup-shaped hypanthium; such cases are said to exhibit perigyny.
Persistent. Remaining attached; not falling off.
Personate. Said of a two-lipped corolla the throat of which is closed by a palate, as in toad-flax.
Petal. One of the separate leaves of a corolla.
Petaloid. Petal-like; of color and shape resembling a petal.
Petiole. Leaf-stalk.

Petiolule. Stalk of a leaflet.
Phalanges (plural of *phalanx*). The groups or bundles of stamens in diadelphous or polyadelphous flowers.
Phenogam, phenogamous. Flowering plants; seed-bearing plants (as distinguished from spore-bearing, or cryptogams).
Phyllodium. Leaf-like petiole and no blade, as in some acacias and other plants.
Phyllotaxy. Order of arrangement of leaves on the stem.
Phytology. The study of plants, particularly of the kinds or species; botany.
Pileate, pileiform. With the form of a pileus or rimless cap; in particular, pertaining to the cap of a mushroom.
Pinna. A primary division or leaflet of a pinnate leaf.
Pinnate. Feather-formed; with the leaflets of a compound leaf placed on either side of the rachis.
Pinnatifid. Cleft or parted in a pinnate (rather than palmate) way.
Pinnatipartite. Pinnately-parted.
Pinnatisect. Cut down to the midrib in a pinnate way.
Pinnule. A secondary pinna or leaflet in a pinnately decompound leaf.
Pip. A perpendicular or upright small rootstock used in propagation, as of lily-of-the-valley.
Pisiform. Pea-shaped; pea-like.
Pistil. The ovule-bearing and seed-bearing organ.
Pistillate. Having pistils and no stamens; female.
Pitted. Having little depressions or cavities.
Placenta. Part or place in the ovary where ovules are attached.
Plaited. Folded lengthwise, as a closed fan.
Plane. Evenly flat, rather than wrinkled, folded, grooved or otherwise.
Platys. In Greek combinations, signifying *broad* or *wide.*
Plumose. Plumy; feather-like; with fine hairs, as the pappus of some composites.
Plumule. The bud in the embryo.
Plur-annual. Of one season's duration only because killed by frost.
Pod. A dehiscent dry pericarp.
Pollen. Spores or grains borne by the anther, containing the male element; sometimes it is not granular.
Pollination. The mechanical or physical operation of transfering pollen from stamen to pistil.
Polliniferous. Bearing-pollen.
Pollinium. A coherent mass of pollen, as in orchids and milkweeds.
Poly-. In Greek combinations, signifying *numerous* or *many.*
Polyadelphous. The stamens in many bundles or fascicles.
Polygamous. Bearing imperfect and hermaphrodite flowers on the same plant.
Polymerous. Of many parts or series.
Pome. Fruit of apple, pear, quince, etc.
Porose. With small holes, pores or perforations.
Posterior. At or toward the back; opposite the front; toward the axis; away from the subtending bract.
Præfoliation. Arrangement of leaves in the bud; vernation.
Præmorse, Jagged; as if bitten off.
Prickle. A small and weak spine-like body borne irregularly on the bark or epidermis.
Prismatic. Prism-shaped; with plane sides separated by angles, body of nearly uniform size throughout, and with similar end-sections.
Process. An extension of any surface or part beyond the main outline.
Procumbent. Trailing or lying flat, but not rooting.
Proliferous. Bearing offshoots or redundant parts; bearing other similar structures on itself.
Proterandrous. Anthers maturing before pistils.
Proterogynous. Pistils maturing before anthers.
Pseud-annual. Perennial by means of bulbs, corms, or tubers.
Pseudo-. In Greek compounds, signifying *spurious* or *false.*
Pseudobulb. The thickened or bulb-form stems of certain orchids, the part being solid and borne above ground.
Puberulent. Somewhat or minutely pubescent.
Pubescent. Covered with short, soft hairs; downy.
Pulverulent. Powdered or dusty.
Pulvinate. Cushioned; with a cushion-like enlargement or structure, as at the base of some petioles or leaflets.
Punctate. With translucent or colored dots or depressions or pits.
Pungent. Ending in a stiff sharp point or tip; also acrid (to the taste).
Putamen. The hard or bony shell of a nut or of a stone-fruit.
Pyrene, pyrena. Nutlet, particularly the nutlet in a drupe.
Pyriform. Pear-formed or -shaped.
Pyxis. Pod opening or dehiscing by a transverse ring.

Quadrangular. Four-angled.
Quaternate. In fours.
Quincunx. Five plants in a square, one of them being in the center.
Quintupled. Five times; multiplied by five.

Raceme. A simple elongated indeterminate cluster with stalked flowers.
Rachilla, rhachilla. A diminutive or secondary axis, or rachis; in particular, in the grasses and sedges the axis that bears the florets.
Rachis. Axis bearing flowers or leaflets; petiole of a fern frond (plural *rachides* or *rachises*).
Radiate. Standing on and spreading from a common center; also, with ray-flowers, as in the Compositæ.
Radical. Belonging or pertaining to the root.
Radicle. The inferior or downward part of the embryo below the cotyledons; caudicle.
Radix. Root.
Rameal. Pertaining to a branch or branches.
Ramenta. Chaffy loose scales borne on leaves and stems, as on the stems of ferns.
Ramification. The mode or style of branching of a plant.
Raphe, rhaphe. The cord or ridge of fibro-vascular tissue connecting the hilum and chalaza on a seed (when the hilum and chalaza are separated).
Ray. Outer modified florets of some composites, with an extended or strap-like part to the corolla; also the branches of an umbel or umbel-like cluster.
Receptacle. Torus; the more or less enlarged or elongated end of the stem or flower-axis on which some or all of the flower-parts are borne; sometimes the receptacle is greatly expanded, as in the Compositæ; sometimes it assumes capsule-like forms, as in the hypanthium of the rose.
Reclinate, reclining. Bent down or falling back from the perpendicular.
Recondite. Concealed; difficult to make out; not easily recognized.
Recurved. Bent or curved downward or backward.
Reflexed. Abruptly recurved or bent downward or backward.
Regular flower. With the parts in each series or set alike; as stamens all like each other, petals all like each other.
Reinforced fruit. With other parts grown to the pericarp.
Remote. Separated by spaces longer than common.
Reniform. Kidney-shaped.
Repent. Creeping; rooting at the joints.
Resupinate. Upside down; turned over.
Retrorse. Bent or turned over back or downward.
Revolute. Rolled backward, margin rolled toward lower side. See *Involute.*
Rhachis. See *Rachis.*
Rhaphe. See *Raphe.*
Rhizome. Underground stem; rootstock.
Rhizos. In Greek compounds, signifying *root.*
Rib. In a leaf or similar organ, the primary vein; also any prominent vein or nerve.
Rimose. With cracks or chinks.
Ringent. Gaping; said of labiate flowers with an open throat or mouth.
Rootstock. Subterranean stem; rhizome.

Rostellum. A little beak; particularly a projection above the stigma in the orchid flower.
Rosula. A rosette, or dense more or less flat imbricated cluster of leaves.
Rosulate. In a rosula or rosette.
Rotate. Wheel-shaped; with short or obsolete tube and a flat and circular limb.
Rotund. Nearly circular; orbicular, inclining to be oblong.
Rudimentary. Incomplete; very little developed.
Ruminated. Chewed; particularly applied to wrinkled albumen in seeds that are irregularly channeled or pierced, as in nutmeg and in annona fruits.
Runcinate. Said of sharply lobed or cut leaves that have the segments directed backward.
Runner. A slender trailing shoot taking root at the nodes.

Sabulose. Growing in or pertaining to sandy places.
Sagittate. Like an arrowhead in form; triangular with the basal lobes pointing downward.
Salver-shaped. With a slender tube and an abruptly expanded flat limb, as that of the phlox; hypocrateriform.
Samara. Indehiscent winged pericarp, as of the maple.
Sap. The watery contents of a plant; an indefinite and undescriptive term little used by botanists.
Sapid. With a pleasant or savory taste.
Scabrous. Rough; feeling roughish or gritty to the touch.
Scale. A name given to many kinds of small mostly dry and appressed leaves or bracts; a vestige.
Scape. Leafless peduncle arising from the ground; it may bear scales or bracts but no foliage-leaves, and may be one- or many-flowered.
Scarious. Leaf-like parts or bracts that are not green, but thin, dry, and membranaceous, often more or less translucent.
Scion. See *Cion.*
Scleroid. Of a hard texture.
Scorpioid. Said of a cluster in which the flowers are 2-ranked and borne alternately at the right and the left.
Seed. The ripened ovule; the essential part is the embryo, and this is contained within integuments.
Seedling. A young plant raised from seed; a plant direct from seed without the intervention of grafting of any kind.
Segment. One of the parts of a leaf, petal, calyx or perianth that is divided but not truly compound.
Self-fertilization. Secured by pollen from same flower; close-fertilization.
Self-pollination. Transfer of pollen from stamen to pistil of same flower; close-pollination.
Sepal. One of the separate leaves of a calyx.
Separation. Multiplication of plants by means of naturally detachable asexual bodies or organs, as offsets, stolons.
Septate. Partitioned; divided by partitions.
Septicidal. Dehiscence along or in the partitions, not directly into the locule.
Septum. A partition.
Sessile. Not stalked; sitting.
Set. Applied loosely to vegetative parts used in propagation, as to offsets, layers, root-cuttings.
Seta. A bristle.
Setiform. Bristle-shaped.
Sheath. Any long or more or less tubular structure surrounding an organ or part.
Shoot. A new plant from the root of the old plant; also any growing twig or axis.
Shrub. A woody plant that remains low and produces shoots or trunks from the base.
Silicle. The short fruit of certain Cruciferæ.
Silique. The long fruit of certain Cruciferæ.
Silky. A condition produced by a covering of soft appressed fine hairs; sericeus.
Silvery. With a whitish metallic more or less shining luster.
Simple pistil. Of one carpel.
Sinus. The space or recess between two lobes of a leaf or other expanded organ.
Slip. A softwood cutting "slipped" off or pulled off; applied also to similar parts cut off.
Smooth. Said of surfaces that have no hairiness, roughness or pubescence, particularly of those not rough.
Solitary. Borne singly or alone.
Sorus. A heap or cluster. The fruit-dots or -cluster of ferns (plural *sori.*)
Spadix. A thick or fleshy spike of certain plants, as the Araceæ, surrounded or subtended by a spathe.
Span. Nine inches; distance from tip of thumb to tip of little finger when the hand is spread out.
Spathe. The bract or leaf surrounding or subtending a flower-cluster or a spadix; it is sometimes colored and flower-like, as in the calla.
Spawn. The dried mycelium of mushrooms used in propagation.
Spheroidal. A solid that is nearly spherical.
Spiciform. Spike-form.
Spiculate. With a small, fleshy and erect point.
Spike. Compact, more or less simple indeterminate, mostly elongated cluster, with flowers sessile or nearly so.
Spikelet. A secondary spike; one part of a compound spike; particularly, one of the ultimate clusters in grasses.
Spine. A strong and sharp-pointed woody body mostly arising from the wood of the stem.
Spinescent. More or less spiny.
Spinule. A little or weak spine.
Spontaneous. Said of plants that have escaped from cultivation, but that do not permanently persist.
Sporangium. A spore-case; a sac or body bearing spores.
Spore. A simple reproductive body, usually composed of a single detached cell, and containing no embryo.
Sporocarp. A receptacle containing sporangia or spores.
Sporophyll. A spore-bearing leaf.
Spreading. Standing outward or horizontally.
Spur. A tubular or sac-like projection from a blossom, as of a petal or sepal; it usually secretes nectar.
Squama. A scale.
Squamella. Very small squama or scale.
Stachys. In Greek compounds, signifying a *spike.*
Stalk. The stem of any organ, as the petiole, peduncle, pedicel, filament, stipe.
Stamen. The pollen-bearing or "male" organ.
Staminate. Having stamens and no pistils; male.
Staminode, staminodium. A sterile stamen, or a structure resembling such and borne in the staminal part of the flower; in some flowers (as in Canna) staminodia are petal-like and showy.
Standard. The upper and broad more or less erect petal of a papilionaceous flower.
Stem. The main axis of a plant; leaf-bearing and flower-bearing as distinguished from the root-bearing axis.
Sterile flower. Without pistils.
Stigma. The part of the pistil that receives the pollen.
Stigmatic. Pertaining to the stigma.
Stipe. The stalk of a pistil or other small organ; also the petiole of a fern-leaf.
Stipel. Stipule of a leaflet.
Stipule. A basal appendage of a petiole; the three parts of a complete leaf are blade, petiole, stipules (usually 2).
Stock. The part on which the cion is grafted; the strain or parentage.
Stolon. A shoot that bends to the ground and takes root; more commonly, a horizontal stem at or below surface of the ground that gives rise to a new plant at its tip.
Stone. The "pit" or putamen of a stone fruit.
Stool. A clump of roots or rootstock that may be used in propagation; also an established low plant from which layers are taken.
Stratification. The operation or method of burying seeds to keep them fresh and to soften their integuments, or to expose them without injury to frost, that they may be more readily and successfully used in propagation.
Strict. Straight and upright, little if any branched, often rigid.
Strobile. Cone.
Strophiole. An appendage or protuberance at the hilum.

Style. More or less elongated part of the pistil between the ovary and stigma.
Stylopodium. Style-foot; an expansion at the base of a style, as in flowers of the Umbelliferæ.
Sub-. As a prefix, usually signifying *somewhat, slightly* or *rather.*
Subacute. Somewhat or partially acute.
Subcoriaceous. Somewhat or approaching leathery in texture.
Subligneous. Partially or somewhat woody.
Subterete. Somewhat or imperfectly terete.
Succulent. Juicy; fleshy; soft and thickened in texture.
Sucker. A shoot arising from the roots or beneath the surface of the ground.
Suffrutescent. Partially or slightly shrubby.
Suffruticose. Pertaining to a low and somewhat woody plant; diminutively shrubby or fruticose; woody at base.
Sulcate. Grooved or furrowed lengthwise.
Superior. Said of an ovary that is free from the calyx.
Supernumerary. Said of buds when there is more than one in an axil.
Suspended. Hanging from the top, as an ovule attached in the top of the locule.
Suture. A line or mark of splitting open; a groove marking a natural division or union; the groove lengthwise a plum or similar fruit.
Symmetrical. Said of a flower that has the same number of parts in each series or circle, as five stamens, five petals.
Symphysis. Growing together; coalescence.
Sympodial. Axial growth continued by successive lateral shoots instead of by terminal bud.
Syncarpium. A fruit consisting of many cohering or consolidated carpels.
Syncarpous. Having carpels united. See *Apocarpus.*
Syngenesious. Anthers united in a ring, as in Compositæ.

Tapering. Gradually becoming smaller or diminishing in diameter or width toward one end.
Tap-root. A strong nearly or quite perpendicular main root that carries the plant axis straight into the ground, all the other roots being secondary to it, rather than branching equally or diversely at the crown.
Taxonomy. Classification of species.
Tendril. A rotating or twisting thread-like process or extension by which a plant grasps an object and clings to it for support; morphologically it may be stem or leaf.
Teratology. The subject of monstrosities, or of abnormal and aberrant forms and malformations.
Terete. Circular in transverse section; imperfectly cylindrical because the object may taper both ways.
Terminology. The subject dealing with names.
Ternate. In threes.
Testa. The outer seed-coat, particularly when bony, hard or brittle.
Tetradynamous. Six stamens, four being long and two short.
Tetragonal. Four-angled.
Thallus. A flat leaf-like organ; in some cryptogams, the entire cellular plant body without differentiation as to stem and foliage.
Throat. The opening or orifice into a gamopetalous corolla, or perianth; the place where the limb joins the tube.
Thyrse, thyrsus. Compact and more or less compound panicle; more correctly a panicle-like cluster with main axis indeterminate and other parts determinate.
Tip. The plant arising at the end of a stolon, as in the black raspberry.
Tomentose. With tomentum; densely woolly or pubescent; with matted soft wool-like hairiness.
Tomentulose. Somewhat or delicately tomentose.
Tortuous. Twisted; with irregular bending and twining.
Torus. Receptacle.
Tree. A woody plant that produces one main trunk and a more or less distinct and elevated head.
Tri-. Three or three times.
Tricarpous. Of three carpels or fruits.
Trichome. A hair, particularly one that is strong or stiff.
Tricostate. With three ribs.
Trifid. Separated about halfway down into three parts.
Trifoliate. Of three leaves.
Trifoliolate. Of three leaflets.
Trigonous. Three-angled.
Trimerous. In threes.
Trimorphous. In three forms; as three lengths of stamens.
Tripinnate. Three times pinnate.
Trisected. In three deeply cut parts.
Triternate. Three times three; the leaflets or segments of a twice ternate leaf again in three parts.
Truncate. Appearing as if cut off at the end; the end nearly or quite straight across.
Tuber. A short congested part; usually defined as subterranean (as of a rootstock), although this is not essential.
Tubercle. A small tuber, or rounded protruding body.
Tuberiferous. Tuber-bearing.
Tuberous. With or resembling a tuber or tubers.
Tumid. Swollen.
Tunicated. Provided with concentric or enwrapping coats or layers, as bulb of onion.
Turgid. Swollen from fullness.

Umbel. Corymbose or indeterminate cluster with branches or rays arising from a common point and about equal in length, resembling framework of umbrella; umbels are characteristic of the Umbelliferæ.
Umbellate. Umbelled; with umbels; pertaining to umbels.
Umbellet. Secondary umbel.
Umbellule. Umbellet.
Uni-. One.
Unisexual. Of one sex; staminate or pistillate only.
Utricle. A small bladder; a bladdery 1-seeded fruit.

Valvate. Opening by valves or pertaining to valves; meeting by the edges without overlapping, as leaves or petals in the bud.
Valve. A separable part of a pod; the units or pieces into which a capsule splits or divides in dehiscing.
Vascular. With vessels or ducts, or relating to them.
Vein. A branch of the evident woody framework of a leaf or similar organ; secondary member of the fibro-vascular structure.
Veinlet. A small or slender vein; nerve.
Venation. Veining; arrangement or disposition of veins.
Ventral. Front; relating to the anterior or inner face or part of an organ; opposite the back or dorsal part.
Vernation. The disposition or arrangement of leaves in the bud.
Versatile. Hung or attached near the middle and usually moving freely, as an anther attached crosswise on the apex of filament and capable of turning.
Verticil. A whorl.
Vesicle. A little bladder or bladder-like cavity.
Vexillary. Pertaining to the vexillum, standard or banner of a papilionaceous flower.
Villous. Provided with long and soft, not matted, hairs; shaggy.
Vitta. An oil-tube, as in the fruits of Umbelliferæ.
Vittate. With vittæ; also striped lengthwise.
Volute. Rolled up.

Watersprout. A strong rapid-growing adventitious shoot in a tree-top or bush or on a trunk.
Whorl. Three or more leaves or flowers at one node, in a circle.
Wing. A thin dry or membranous expansion or flat extension or appendage of an organ; also the lateral petal of a papilionaceous flower.
Woolly. Provided with long, soft and more or less matted hairs; like wool; lanate.
Wort. Old word for a plant or herb; now used only in combination, as *motherwort, spiderwort, liverwort.*

V. Anemone coronaria, an old garden favorite.

A

ABACÁ, or Manila hemp, is the fiber of *Musa textilis*, a native of the Philippine Islands, where it is grown for commerce. The plant is like the banana in general habit of growth, although it is seed-bearing. It is propagated by seeds or suckers or root-cuttings. When two to five years old it is at maturity, reaching a height of 6 to 15 feet and a diameter of trunk of 6 to 15 inches. The fiber is derived from the thick sheathing leaf-stems, the stems being cut between the flowering and fruiting stages. After seed-bearing, the top or "plant" dies and new suckers or shoots spring from the roots. The first stalks may be cut as early as twenty months after planting, and the plantation is cut over about once in eight months until it becomes unproductive, which will be fifteen to forty years. New stalks continue to arise as the old ones are cut. The fiber, as found in the market, is coarse and stiff and 6 to 12 feet long. In the better grades it is very strong. The fruit of *Musa textilis* is not edible. See Cyclo. Amer. Agric. II, p. 286, and I, p. 126.

ABÈLIA (bears the name of Dr. Clark Abel, physician and author in China, d. 1826). *Caprifoliàceæ*. Ornamental plants, cultivated chiefly for their handsome flowers.

Shrubs: lvs. opposite, short-petioled, small or medium-sized, entire or dentate: fls. in 1- to several-fld. cymes, axillary or terminal on short branchlets, sometimes forming panicles at the end of the branches; sepals 2–5, conspicuous, persistent; corolla tubular or campanulate, 5-lobed; stamens 4, paired; ovary 3-celled, only 1 cell fertile; style elongated: fr. 1-seeded leathery achene crowned by the persistent calyx.—More than 20 species in E. and Cent. Asia, 1 on the Himalayas and 2 in Mex. For a key to all the species, see Rehder, Synopsis of the genus Abelia (in Sargent, Plantæ Wilsonianæ, I, pp. 122–129). The genus is sometimes united with Linnæa.

The abelias are small or medium-sized bushy shrubs with deciduous or persistent foliage and rather small but numerous flowers varying from white to pink or purple; after the flowers have fallen, the persistent usually purplish sepals are attractive. The recently introduced *A. Graebneriana* and *A. Engleriana* are probably the hardiest; *A. triflora*, *A. chinensis* and *A. grandiflora* are hardy as far north as Philadelphia: the last-named is sometimes grown in sheltered situations as far north as Massachusetts, and, even if partly killed back, the young shoots flower profusely the same season; *A. floribunda* is hardy only south of Washington, D. C.

The cultivation of abelias presents no special difficulties. They do best in sunny, sheltered positions and prefer a well-drained soil enriched by peat or leaf-mold. *A. floribunda* is sometimes grown in pots and kept during the winter in the cool greenhouse; in this case a sandy compost of loam and peat or leaf-mold will be a suitable mixture.

Propagation is usually by greenwood cuttings in summer under glass; also by cuttings of ripened wood taken in fall. Seeds are not often obtainable; they are sown in spring and germinate after a month or two; the seedlings begin to bloom usually in their third year.

58. Abelia grandiflora. (×½)

A. *Sepals 2.*

Graebneriàna, Rehd. Shrub, 4–10 ft.: lvs. deciduous, ovate to oblong-ovate, acuminate, 1½–2 in. long, remotely serrate, usually finely ciliate and hairy on midrib beneath, sometimes with scattered hairs above: fls. usually few at the end of short branchlets along last year's branches; sepals ⅓in. long, oblong; corolla campanulate, 1 in. long, pink with yellow throat. Summer. China.

Engleriàna, Rehd. (*Linnæa Engleriàna*, Graebn.). Shrub, 3–6 ft.: lvs. deciduous, ovate to elliptic-ovate, acute or acuminate, about 1 in. long, with few small teeth: fls. in few-fld. clusters in the axils of fascicled lvs. along last year's branches, rosy purple or rosy pink, a little over ½in. long. Summer. China.—Similar to the preceding but smaller in every part, flowering more profusely and therefore handsomer. Has proved hardy at the Arnold Arboretum.

AA. *Sepals varying from 2 to 5 on the same plant and often partly connate.*

grandiflòra, Rehd. (*A. chinénsis* × *uniflòra*. *A. rupéstris*, Hort., not Lindl. *A. rupéstris* var. *grandiflòra*, André. *A. uniflòra*, Hort., not Turcz. *Linnæa Spaethiàna*, Graebn. *L. Perringiàna*, Graebn.). Fig. 58. Lvs. ovate, rounded or attenuate at the base, acute, ¾–1½ in. long, serrate, shining above, nearly glabrous, half-evergreen: fls. in terminal, loose panicles, white flushed pink, campanulate, ¾in. long; stamens not exserted. Of garden origin. Gt. 41:1366. Gn. 76, p. 528. J.H. III. 8:77.—One of the hardiest and most free-flowering abelias; it flowers continuously from June to Nov.

AAA. *Sepals 5.*

chinénsis, R. Br. (*A. rupéstris*, Lindl.). Shrub, 3–6 ft.: lvs. ovate, rounded at the base, ¾–1½ in. long, serrate, hairy on the midrib beneath and sometimes with scattered hairs above, deciduous: fls. in terminal dense panicles, funnelform, white, ½in. long; sepals oblong, ¼in. long; stamens exserted. Summer. China. B.R. 32:8. Gn. 27, p. 424. P.F.G. 2:201. G. 8:143.—*A. rupestris* is sometimes considered a distinct species, but the differences are very slight.

triflòra, R. Br. Shrub, to 10 ft., branchlets with reflexed hairs: lvs. lanceolate or ovate-lanceolate, 1½–2½ in. long, ciliate and sparingly hairy on both sides or nearly glabrous, entire or occasionally on vigorous shoots with a few coarse teeth, half-evergreen: fls. in terminal clusters, fragrant; sepals linear, hairy, ½in. long; corolla tubular with spreading limb, white flushed pink, ¾in. long. Summer. Himalayas. P.F.G. 3:91. Gn. 10:29. G.C. II. 16:34. G. 29:483. R.H. 1870:511. J. F. 3, pl. 319.—A very handsome species; after the

flowers are gone the feathery sepals remain as an attractive feature.

floribúnda, Decaisne. Shrub, 4 ft.: lvs. persistent, oval to oval-oblong, ½–1 in. long, crenate-serrate, ciliate: peduncles axillary, 1–3-fld.; corolla carmine-purple, nodding, tubular, 1½ in. long; sepals oblong, ½in. long. Summer. Mex. B.M. 4316. F.S. 2:5. R.B. 23:157. Gn. 13:120. B.R. 33:55. R. H. 1912:544.

A. biflòra, Turcz. Lvs. ovate-lanceolate, hairy, coarsely serrate, deciduous: fls. white, tubular, in 2's; sepals 4. Manchuria, N. China.—*A. serràta,* Sieb. & Zucc. Similar to A. biflora. Fls. funnelform, pink, little over ½in. long, in 2's; sepals 2. Japan. S.Z. 1:34.—*A. spathulàta,* Sieb. & Zucc. Allied to A. biflora. Lvs. ovate: fls. over 1 in. long, white tinged yellow in throat; sepals 5. Japan. S.Z. 1:34. B.M. 6601. G. 27:345. G.M. 45:335 (as A. serrata).—*A. uniflòra,* R. Br. (A. serrata, Nichols., not Sieb. & Zucc.). Lvs. persistent, ovate-lanceolate: fls. in loose terminal panicles, campanulate, 1 in. long, rosy white with yellow in throat; sepals 2. China. B.M. 4694. F.S. 8:824. J.F. 4, pl. 380. B.H. 3:338. G.C. III. 37:323. Gn.W. 21:933 (as A. chinensis). Gn. 27, p. 425.

ALFRED REHDER.

ABELÍCEA: *Zelkova.*

ABELMÓSCHUS: *Hibiscus.*

ABÈRIA (named from Mt. Aber, Abyssinia, where first species was found). *Doryàlis,* Arn. & E. Mey. *Flacourtiàceæ.* Small trees or shrubs, with alternate, simple exstipulate leaves and small inconspicuous flowers. Flowers dicœcious; staminate fls. with a 4–5-parted calyx and no petals, and with many stamens, arranged on a fleshy receptacle; pistillate fls. with a 5–7-parted, persistent calyx and no petals, the ovary free, sessile, 1–6-celled, on a lobed usually fleshy disk; fr. fleshy, indehiscent.—Eleven species in Afr. and Ceylon.

cáffra, Hook. f. & Harv. Fig. 59. Thorny, glabrous: lvs. obovate, obtuse, cuneate at base, entire: fls. dicœcious, apetalous. G.C. III. 18:737. R.H. 1904:256. —The kei apple of the Cape of Good Hope; a spiny plant grown S. for hedges; is considered promising for S. Calif. and S. Fla. as a fr. plant. Fruit acid, used as pickles or conserves. Proves quite hardy in S. Calif.

Gárdneri, Clos. A small, much-branched tree, 16–20 ft.: lvs. 2½–4 in. long, lanceolate or oval, acute at both ends: fls. greenish, staminate fls. in umbellate clusters, the pistillate axillary in the branches: fr. 1 in. diam., pale purple, edible. June. India and Ceylon.

N. TAYLOR.†

59. Aberia caffra. (fr. ×⅓)

ÀBIES (derivation doubtful). *Pinàceæ.* FIR, but the name spruce is often erroneously applied. Tall, pyramidal trees of temperate and cool climates, planted for ornament and for shelter, and also for timber. The word àbi-es is pronounced in three syllables, the *e* being long.

Leaves lanceolate or oblanceolate, entire, sessile, persistent for many years; on young plants and lower sterile branches flattened, usually deep green and lustrous above and silvery white beneath from the presence of many rows of stomata, rounded and variously notched at the apex, appearing 2-ranked by a twist at their base; on upper fertile branches crowded, more or less erect, often incurved or falcate, thickened or quadrangular, obtuse or acute: fls. axillary, appearing in early spring from buds formed the previous summer on branchlets of the year, surrounded by involucres of the enlarged scales of the fl.-buds; staminate fls. pendent on branches above the middle of the tree; pistillate fls. globular, ovoid or oblong, erect on the topmost branches: fr. an erect ovoid or oblong cylindrical cone, its scales longer or shorter than their bracts, separating at maturity from the stout persistent axis. Northern and mountainous regions of the northern hemisphere, often gregarious. Twenty-three species are distinguished; greatest segregation on the Cascade Mts. of Ore., in the countries adjacent to the Medit., and in Japan. Many species which have been referred to Abies are now included in Picea. S.S. 12. Heinrich Mayr, Monographie der Abietineen des Japanischen Reiches. Gn. 11, pp. 280, 281. See *Arboriculture.*

All the species of abies produce soft, perishable wood, sometimes manufactured into lumber, and balsamic exudations contained in the prominent resin vesicles in the bark characteristic of the genus. They are handsome in cultivation, but usually of short-lived beauty. The firs prefer moist, well-drained soil. As timber-producing trees, the species of abies are less valuable than the spruces (Picea) and in the United States they have not been planted except for ornament. In Europe, where this tree is sometimes planted as a forest crop, the wood of the European *A. Picea* is valued, and in the Pacific states the wood of *A. grandis, A. concolor* and *A. magnifica* is employed in the manufacture of fruit-boxes and woodenware.

In cultivation, firs are most beautiful while young, and usually lose their lower branches and become thin and unsightly as they grow older, and many of the species have little ornamental value for more than fifty years. In the northern and eastern states, the most valuable ornamental species are the Colorado form of *A. concolor,* with pale or bluish foliage, and the Japanese *A. brachyphylla,* with leaves that are dark green and very lustrous above and silvery beneath. In the United States, *A. brachyphylla* assumes a compact pyramidal form of growth, but in Japan old trees become, unlike those of any other fir, round-headed. The other Japanese fir that has been cultivated in the United States long enough to show its value as an ornamental tree, *A. Veitchii,* produces longer branches than *A. brachyphylla* and is of more open habit and is less valuable for ornamental use. After *A. concolor* and *A. brachyphylla,* the best fir trees for the eastern United States are *A. cilicica* from Asia Minor and *A. Nordmanniana* from the Caucasus. In its young state, *A. cilicica* forms a dense pyramid of gray-green foliage and as it grows in the Pinetum at Wellesley, Massachusetts, is an object of great beauty. *A. Nordmanniana* is one of the commonest fir trees cultivated in the eastern states, although it sometimes suffers from cold in New England, where it frequently becomes thin and unsightly. In the middle states, however, it is often an object of great beauty. The two eastern American species, *A. balsamea* and *A. Fraseri,* and the related species from the Rocky Mountains, *A. lasiocarpa,* grow badly in cultivation, and are short-lived and not handsome. Of the Pacific coast species, *A. grandis* can be kept alive in favorable situations in the eastern states, and *A. amabilis,* which grows slowly always in cultivation, is hardy but gives little promise of becoming of much value anywhere except on the mountains of northeastern America. The summers in the southern states are too hot for the successful cultivation of fir trees, and the climatic conditions of the Mississippi Valley are not favorable for their successful growth. In the parks and gardens of the Pacific states, fir trees grow better than in any other part of

North America, and in the neighborhood of the Pacific Ocean can be grown successfully the firs of western North America, Mexico, Europe, India and eastern Asia.

Propagation is mostly by seeds. The percentage of fertile seeds produced by firs is much smaller than that yielded by spruces and pines, and small crops of seedlings are often secured from large sowings of the seeds. The seeds lose their fertility sooner than those of many conifers and cannot be safely kept more than one or two years; they should be planted in carefully prepared seedbeds and covered with soil to a depth equal to the thickness of the seed. Young plants begin to appear at the end of a few weeks, and, as they are extremely sensitive to the heat of the sun, they need the protection of lath or brush screens. Like other conifers, the different species can be propagated by side-grafting on other species of the genus. Grafted plants, however, are less valuable than seedlings and propagation in this way is slow and expensive, as the work must be performed in glass houses. The leading or other upright-growing shoot should be chosen for the graft, as trees obtained by the use of lateral branches for grafts do not often grow into erect or shapely trees. The species most commonly used for stocks are *A. Picea* and *A. balsamea*.

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A. *Euabies. Lvs. flat, grooved on the upper surface, only occasionally stomatiferous above on upper fertile branches.*

B. *Lf. blunt.*

C. *Foliage essentially green,—the lvs. green above and whitish only beneath.*

D. *Cones usually upward of 4 in. long.*

1. **Pìcea,** Lindl. (*A. pectinàta*, DC.). Silver Fir. Fig. 60. Tree, 100–200 ft.: trunk 6–8 ft. in diam.: lvs. flat, distichously spreading, dark green and lustrous above, silvery white below: cones slender, cylindrical, light green to dark purple, 5–6 in. long; bracts slightly longer than their scales. Mts. of Cent. and S. Eu., often gregarious.—Wood esteemed and much used; yields Strasburg turpentine. Dwarf forms, with erect and pendulous and with much abbreviated branches, are common in gardens. Not perfectly hardy in New England.

2. **Nordmanniàna,** Spach. Fig. 61. Tree, 100–150 ft.: trunk 4–6 ft. in diam.: lvs. flat, crowded, dark green and very lustrous above, silvery white below: cones oblong-cylindrical or ellipsoidal, dark orange-brown, 4–6 in. long; bracts as long as or slightly longer than their scales. Mts. south and southeast of the Black Sea, and western spurs of the Caucasus. B.M. 6992. Gng. 6:51. G.C. II. 19:797.—Often hardy; one of the most desirable firs in the middle states. Var. **aûreo-variegàta,** Hort. Shoots colored a pure golden yellow.

3. **cilícica,** Carr. Tree, 45–60 ft.: trunk 2–3 ft. in diam.: lvs. narrow, flat, pale green above, silvery white below: cones stout, cylindrical, orange-brown, 5–6 in. long; bracts rather shorter than their scales. At high elevations on the Anti-Taurus of Asia Minor, and on the Lebanon. A.G. 16:255. Gng. 4:113.—Begins to grow early in the spring and is often injured by late frosts; hardy and desirable in the northern states.

4. **amábilis,** Forbes. White Fir. Tree, 100–150 ft.: trunk 4–6 ft. in diam.: lvs. crowded, dark green and very lustrous above, silvery white below, occasionally stomatiferous on the upper surface: cones oblong, dark purple, 3½–6 in. long; bracts much shorter than their scales. Cascade Mts. of Wash. and Ore., and Coast Ranges from Vancouver Isl. to Ore. S.S. 12:614. G.C. II. 14:721, 725; III. 30:191.—One of the handsomest of the genus, often forming groves at high elevations; in cult. grows slowly, and is not satisfactory.

DD. *Cones usually under 4 in. long.*

5. **sibírica,** Ledeb. (*A. pichta*, Forbes). Tree, 60–100 ft.: trunk 2–4 ft. in diam.: lvs. crowded, dark yellow-green: cones cylindrical, slender, brownish yellow, 2½–3 in. long; bracts much shorter than their scales. N. and E. Russia to Kamtschatka and Mongolia, gregarious on the Altai Mts.—Very hardy, the early growth often injured by late frosts; in cult. soon becomes thin and loose in habit.

60. Cones of Abies.—From bottom to top, A. grandis, A. balsamea, A. Picea.

6. **balsàmea,** Mill. Balsam Fir. Balm of Gilead Fir. Fig. 60. Tree, 50–80 ft.: trunk 17–30 in. in diam.: lvs. dark green and lustrous above, pale below, rounded or obtusely short-pointed and occasionally emarginate, acute or acuminate on fertile branches: cones oblong, cylindrical, purple, 2½–4 in. long; bracts shorter or rarely slightly longer than their scales. E. N. Amer. from Labrador and the valley of the Athabasca to Iowa and the mts. of Va. S.S. 12:610. G.C. III. 17:423, 425, 431.—Wood occasionally used for lumber; Cana-

dian balsam, or balsam of fir, is obtained from the bark; in cult. loses its beauty early. Var. **columnàris**, Hort. Branches very short, turned upward at the ends. Var. **hudsônia**, Engelm. (*A. hudsónica*, Hort.), is a dwarf form. Var. **lutéscens**, Hort. Lvs. white, yellow or straw-colored when exposed to the sun.

7. **Frâseri**, Poir. SHE BALSAM. Tree, 30–50 or even 70 ft.: trunk reaching 2½ ft. in diam.: lvs. flat, obtusely short-pointed, twisted at the base so as to appear to be crowded on the upper side of the branches, dark green and lustrous: cones oblong-ovate or nearly oval, rounded at the slightly narrower apex, purple, 2½ in. long and 1 in. thick, the scales twice as wide as long, and at maturity nearly half covered by the ends of the pale reflexed bracts. Mts. of Va., Tenn., and N. C. S.S. 12 : 609. G. F. 2 : 475.—Too much like the balsam fir to be prized as an ornamental tree. Trees sold under this name are nearly always forms of *A. balsamea*. Very short-lived in cult.

61. Cones of Abies.—From bottom to top, A. concolor, A. Nordmanniana, A. magnifica.

8. **grândis**, Lindl. (*A. amábilis*, Murr., not Forbes. *A. Gordoniàna*, Carr. *Pìcea grándis*, Loud.). Fig. 60. Tree, 200–300 ft.: trunk becoming 4 ft. in diam.: lvs. thin and flexible, deeply grooved, very dark green above and silvery white beneath: cones cylindrical, 2–4 in. long, rounded or retuse at the apex, the broad scales somewhat squarrose and irregularly serrate and furnished with a short point. Coast of N. Calif. to Vancouver Isl. and to the western slopes of the Rocky Mts. of Mont. S.S. 12:612. Gn. 38, p. 291. G.C. II. 15:179, 181. R.H. 1894, p. 274.—Occasional specimens are seen in choice grounds, but it rarely does well in the eastern states.

CC. *Foliage pale blue or glaucous.*

9. **côncolor**, Lindl. & Gord. (*A. Lowiàna*, A. Murr. *A. Parsonsiàna*, Hort., the Pacific form). WHITE FIR. Fig. 61. Tree, 100–250 ft.: trunk 4–6 ft. in diam.: lvs. elongated, stomatiferous on the upper surface, on fertile branches often falcate and thickened and keeled above: cones oblong, gray-green, dark purple or bright canary-yellow, 3–5 in. long; bracts shorter than their scales. W. N. Amer. from S. Ore. to Low. Calif. and to Utah, S. Colo., New Mex., Ariz. and Sonora. S.S. 12:613. G.C. II. 13:649; II. 15:661; III. 8:748, 749; III. 35:59.—Of all fir trees, the Colorado form best withstands heat and drought; very hardy, grows rapidly, and the most desirable of the genus in the eastern states. The form from the Pacific coast is less hardy and less desirable in the E. as an ornamental tree. Seedlings of the Colorado form, with rather longer and more glaucous leaves, are found in nurseries as *A. côncolor violàcea*. Var. **aùrea**, Beiss. Young shoots golden yellow in May, afterward becoming silver-gray. Var. **brevifôlia**, Beiss. Lvs. short and obtuse, twice as broad as in typical form. Var. **falcàta**, Niem. Lvs. sickle-shaped, curved upward. Var. **globôsa**, Niem. Plant spherical, with symmetrical small branches.

BB. *Lvs. pointed, especially on main shoots, and usually rigid.*

10. **Vèitchii**, Lindl. (*A. nephrólepis*, Maxim.). Tree, 80–100 ft.: trunk 3–4 ft. in diam.; branchlets slender, pubescent: lvs. crowded, dark green and lustrous above, silvery white below: cones cylindrical, slender, dark purple, 2–2½ in. long; bracts shorter than their scales. Mts. of Cent. Japan; gregarious and forming great forests, coast of Manchuria. G.C. II. 13:273.—Very hardy in the northern states, and when young is one of the most beautiful of fir trees.

11. **brachyphýlla**, Maxim. Tree, 80–100 ft.: trunk 6 ft. in diam.; upper branches long and vigorous, ultimately forming a broad, round-topped head: lvs. elongated, sharp-pointed, dark green and very lustrous above, silvery white below: cones cylindrical, stout, dark purple, 3–3½ in. long; bracts much shorter than their scales. Mts. of Cent. Japan, singly or in small groves. B.M. 7114.—Very hardy, and when young one of the most desirable of the fir trees for the northern states.

12. **cephalónica**, Loud. Tree, 60–70 ft.: trunk 2–4 ft. in diam.: lvs. broad, rigid, sharp-pointed, standing out from the branches at right angles: cones cylindrical, slender, pointed, gray-brown, 5–6 in. long; bracts longer or rarely shorter than their scales. Mt. Enos, on the Isl. of Cephalonia. Gng. 6:49. G.W. 5, p. 15; 12, p. 399; 14, p. 538.—Doubtfully hardy in northern states.

Var. **Apôllinis**, Boiss. (*A. Apóllinis*, Link), with narrow and blunter lvs., is remarkable in its power to produce vigorous shoots from adventitious buds. Mts. of Greece and Roumelia; often gregarious; more hardy than the type in the northern states. Page 3565.

13. **Pinsàpo**, Boiss. SPANISH FIR. Tree, 70–80 ft.: trunk 4–6 ft. in diam.: lvs. short, broad, rigid, sharp-pointed, bright green, spreading from all sides of the stiff branchlets: cones cylindrical, slender, gray-brown, 5½–6 in. long; bracts shorter than their scales. Mts. of Cent. and S. Spain; often gregarious. G.C. III. 21:407; 29:65; 31:407.—Not hardy north of the middle states.

AA. *Nobiles. Lvs. blue-green, often glaucous, stomatiferous on both surfaces, flat or 4-sided on sterile branches, 4-sided acute, incurved and crowded on fertile branches.*

14. **nóbilis**, Lindl. (*Pìcea nóbilis*, Loud.). RED FIR. Tree, 150–250 ft.: trunk 6–8 ft. in diam.: lvs. on lower branches grooved above, rounded and emarginate at the apex: cones oblong-cylindrical, purplish or olive-brown, 4–6 in. long; bracts much longer, thin and covering the scales, strongly reflexed, pale green. Cascade and Coast Mts. of Wash. and Ore.; often gregarious. S.S. 12:617. G.C. II. 19:15; III. 20:275.—There is a var. **glaùca** in the trade.

15. **magnífica**, A. Murr. RED FIR. Fig. 61. Tree, 200–250 ft.: trunk 6–10 ft. in diam.: lvs. quadrangular, bluntly pointed on sterile and acute on fertile branches: cones oblong-cylindrical, purplish brown, 6–9 in. long;

bracts much shorter than the scales. Sierra Nevada of Calif.; gregarious and forming great forests. S.S. 12: 618. Gn. 37, p. 591.—Wood occasionally manufactured into lumber. Less hardy in the eastern states than *A. nobilis*.

Var. **shastènsis**, Lemm., of S. Ore. and N. Calif., cones somewhat smaller, with bracts as long as or longer than the scales. S.S. 12:620.

A. Albertiàna, Murr.=Tsuga heterophylla.—*A. baborénsis*, Let. Lvs. dark, silvery below, very numerous, ½–1 in. long: cones 4 or 5 together, reaching 7 or 8 in. long, 1 in. diam. N. Afr. R.H. 1866, p. 106, desc.—*A. bífida*, Sieb. & Zucc.=A. firma.—*A. bracteàta*, Hook. & Arn.=A. venusta.—*A. canadénsis*, Michx.=Tsuga canadensis.—*A. Delávayi*, Franch. Tree, 20–50 ft.: lvs. rolled back along margin. W. China. G.C. III. 39:212.—*A. Fargèsii*, Franch. Tree, to 200 ft.: lvs. very white on under surface: cones deep purple. Cent. and W. China. G.C. III. 39:213.—*A. firma*, Sieb. & Zucc.= A. Mome, Sieb. Lvs. thick and rigid, 1 in. long: cones cylindrical, often 6 in. long, with keeled scales.—*A. homólepis*, Sieb. & Zucc. Closely related to A. brachyphylla but less valuable as an ornamental tree; rare in cult. (Arnold Arboretum.) G.C. II. 12:823. Japan. Promising for the southern states.—*A. Hookeriàna*, Murr.=Tsuga Mertensiana.—*A. lasiocárpa*, Nutt. Lvs. blue-green and glaucous: cones 3 in. long, with very broad spineless scales. W. U. S. G.C. II. 13:9. G.F. 4:380. Gng. 4:373. S.S. 12:611.—Var. *arizónica* is a form from the mts. of Ariz. with thicker, paler and more corky bark, the result probably of climatic influence.—*A. macrocárpa*, Vasey=Pseudotsuga macrocarpa.—*A. Màriesii*, Mast. Small tree with crowded branches and short, dark foliage which is pale below: cones large, dark purple. N. Japan. G.C. II. 12:789.—*A. Mentensiàna*, Lindl.=Tsuga heterophylla.—*A. numídica*, Carrière=A. baborensis.—*A. Pindrow*, Spach. Himalayas. This now being recognized as distinct from A. Webbiana.—*A. Reginæ Amáliæ*=A. cephalonica var. Apollinis.—*A. religiòsa*, Lindl. Long, slender, drooping branches: lvs. silvery below: cones 5 in. long. Mex. B.M. 6753.—*A. sachalinénsis*, Mast. Tall tree, with pale bark, white buds, and long, slender, dark green lvs.: cones 3 in. long. E. Asia. G.C. II. 12:589.—*A. subalpina*, Engelm.=A. lasiocarpa. G.C. II. 15:236, 237.—*A. venùsta*, Koch. Lvs. acuminate, dark yellow, green above and silvery below: cones 4 in. long, with long, slender bracts. Calif. S.S. 12:615, 616. B.M. 4740.—*A. Webbiàna*, Lindl. Lvs. 1–2½ in. long, flat, silvery below: cones cylindrical, 6 or 7 in. long. Himalayas. See *Picea* for *A. ajanensis*, *alba*, *Alcockiana*, *Engelmanni*, *excelsa*, *Gregoriana*, *miniata*, *Morinda*, *nigra*, *obovata*, *orientalis*, *pendula*, *polita*, *pungens*, *Schrenkiana*, *Smithiana*. See, also, *Pseudotsuga* and *Tsuga*.

C. S. SARGENT.

ABÒBRA (Brazilian name). *Cucurbitàceæ*. A monotypic genus allied to Cucurbita. The only species is a greenhouse climber, cult. for its numerous small, showy frs.: grows rapidly, and may be planted out in summer. The tuberous roots are stored like dahlias. Prop. by seeds or rarely by soft cuttings.

Flowers dicœcious green, all axillary and solitary; staminate fls. with a tubular, cup-shaped calyx and a rotate 5-parted corolla, having oblong-lanceolate segms.; stamens 3, free, the anthers thick, and 1-celled, or sometimes 2-celled; pistillate fls. with a 3–4-celled ovary followed by an ovoid, indehiscent, 6-seeded, showy fr.

tenuifòlia, Naudin (*A. viridiflòra*, Naudin). Height 10–15 ft.: lvs. much divided: fls. small, pale green, fragrant: fr. a scarlet gourd. Trop. Amer. R.H. 1862:111.

ABRÒMA (from *a*, not, and *broma*, food). *Sterculiàceæ*. A genus of 2 or 3 species, closely related to the cacao; grown as evergreen greenhouse trees, but apparently not in cult. except in botanical collections. Fls. dingy purple, the calyx 5-parted; corolla lobes 5, clawed. Prop. by seeds or by cuttings in spring from half-ripened wood under glass. Probably not in cult.

A. augùsta, Linn. f. Lower lvs. cordate, 3–5-lobed; upper lvs. ovate-lanceolate. Trop. Asia. B.R. 518.—*A. fastuòsa*, R. Br. Lower lvs. cordate, 5-lobed; upper lvs. ovate: fls. dark purple. Trop. Asia, Austral. *A. sinuòsa*, Nichols. Lvs. ovate pedately pinnatifid, on slender petioles. Madagascar.

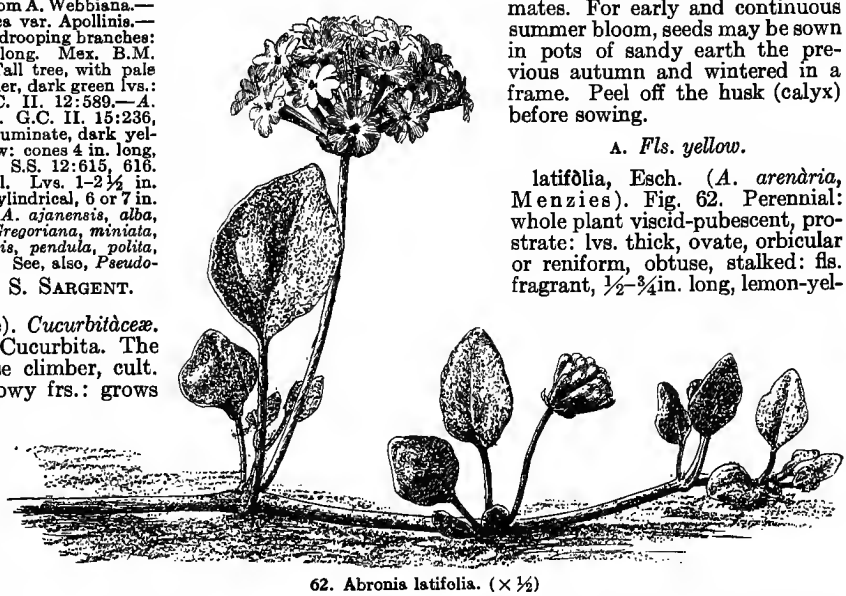
N. TAYLOR.†

ABRÒNIA (from Greek *abros*, delicate, referring to the involucre). *Nyctaginàceæ*. SAND VERBENA. Trailing and upright annuals or perennials, with fragrant verbena-like flowers, suitable for baskets, rockeries or the open border.

Herbs, often viscid: lvs. opposite from swollen nodes, unequal, petioled and entire: fls. 1 to many in a bracted peduncled head, small, salver-form, red, yellow or white, showy in mass, fragrant; stamens mostly 5, unequal, joined to the corolla-tube and included within it; calyx tubular and corolla-like, 4–5-lobed, the base persistent over the 1-seeded ovary or fr. About 30 species in Amer. S. Watson, Bot. Calif. 2:3–5; P.C. Standley, Contr. U. S. Nat. Herb, 12:306.

Abronias are garden annuals, or treated as annuals, of secondary importance. They are low or trailing plants, rising from 6 to 18 inches high and spreading widely. They are best adapted to open sunny places and light soil. *A. umbellata* is the common garden species, the trailing stems often reaching a length of 3 to 5 feet, and the flowers appearing all summer and fall; in mild climates, the plant volunteers from self-sown seeds. It is useful for borders and for baskets and porch-boxes, when a change or variety is wanted from the use of verbenas. Under glass, the plant is nearly perennial.

Propagation is by seeds, sown in open ground after frost, or sown in late summer or early fall in mild climates. For early and continuous summer bloom, seeds may be sown in pots of sandy earth the previous autumn and wintered in a frame. Peel off the husk (calyx) before sowing.



62. Abronia latifolia. (× ½)

A. *Fls. yellow.*

latifòlia, Esch. (*A. arenària*, Menzies). Fig. 62. Perennial: whole plant viscid-pubescent, prostrate: lvs. thick, ovate, orbicular or reniform, obtuse, stalked: fls. fragrant, ½–¾in. long, lemon-yellow. June, July. Seacoasts, Cent. Calif. and N. B.M. 6546. G.C. II. 16:365.

AA. *Fls. pink or rose.*

umbellàta, Lam. (*Tricràtus admirábilis*, L'Her. *A. ròsea*, Hartweg.) Fig. 63. Perennial: similar in habit and pubescence to the above, but lvs. stalked, the blade ovate, acute at both ends: fls. pink, about ½in. May, June. Calif. seacoasts to Columbia R. F.S. 11:1095. P.M. 16:36. Var. **grandiflòra**, Hort., has larger fls. and lvs.

villòsa, Wats. Perennial: smaller and slenderer than *A. umbellata* and covered with a glandular-villous pubescence: lvs. rarely 1 in. long: fls. 5–15 in a cluster, rose. Calif., Utah.—Not common in cult., but well suited to sandy and dry situations. Intro. 1891.

AAA. *Fls. white.*

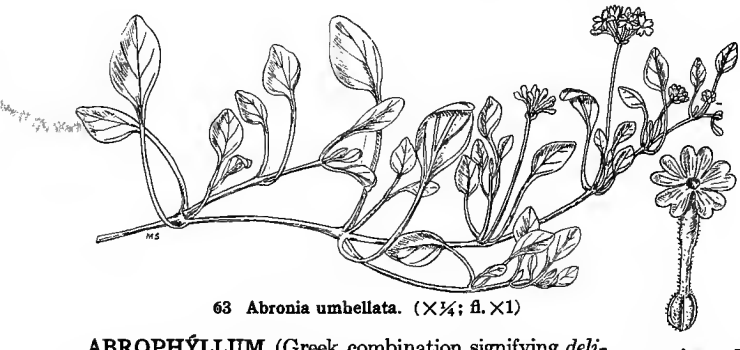
mellífera, Dougl. (*A. Suksdórfii*, Coult. & Fisch.). Perennial: stouter than *A. umbellata*: st. finely hairy: involucre larger, scarious: fls. 1 in. long, the tube

greenish and glabrous: lvs. long-stalked, in opposite pairs. Wash., Ore. B.M. 2879. Intro. 1891.

frágrans, Nutt. Erect perennial: lvs. ovate or elliptical, paler beneath than above: fls. night-blooming, ¾–1 in. long, the tube greenish, the white lobes bifid. Columbia R. to New Mex. B.M. 5544.

A. puchélla, Nichols. Erect, 6 in.: fls. pinkish rose.—*A. Crux-máltæ,* Kellog, the handsomest of all the species is, Tripterocalyx Crux-maltæ, which see.

N. Taylor.†



63 Abronia umbellata. (×¼; fl. ×1)

ABROPHÝLLUM (Greek combination signifying *delicate-leaved*). *Saxifragàceæ.* An endemic monotypic genus of New S. Wales: tall, handsome shrub: lvs. alternate, elliptic or ovate-lanceolate and acuminate, to 9 in. long, somewhat toothed: fls. small, yellowish, in dichotomous corymbose panicles terminating the shoots or arising from the upper axils; petals, stamens and calyx-lobes 5: fr. a 5-celled ovoid berry. **A. ôrnans,** Hook. f., was intro. to Calif. in 1911 by Franceschi.

ÀBRUS (from *abros,* delicate, referring to leaves). *Leguminòsæ.* Deciduous greenhouse climber, or used South outdoors for screens. Roots a poor substitute for licorice, and the seeds are violently poisonous. Needs strong heat for indoor culture. Propagation is by seeds or by cuttings under glass in sand.

The genus consists of usually creeping or climbing woody herbs with primately compound lvs.: fls. small, in dense racemes on axillary peduncles or short branches; calyx bell-shaped, the teeth very short; corolla pea-like, much exserted; stamens 9, in a tube.

precatòrius, Linn. Crab's-eye Vine. Weather-Plant. Fig. 64. Height 10–12 ft.; frequently trailing over the ground S.: lfts. oblong, in numerous pairs: fls. varying from rose to white: seeds bright scarlet, with a black spot, used by Buddhists for rosaries, in India as standards of weight, and in the W. Indies in bead work. Seeds irritant; also used as an abortive in U. S. A variety with a cream-colored bean is offered by Reasoner Bros.: Tropics generally.—The claims made for its weather-foretelling properties are exposed by Oliver in Kew Bull. Jan., 1890. It does, however, "go to sleep" during storms, but this is a feature of other legumes. Sometimes confounded with *Rhynchosia phaseoloides* (*R. precatoria*), which has similar seeds, but is a very different plant with large, 3-foliolate, bean-like lvs.

N. Taylor.†

ABSINTH, ABSINTHE (ab'sinth). A liquor made from plants of the wormwood group, particularly from the absinthium (*Artemisia Absinthium*). These are aromatic or bitter herbs. *A. Absinthium* yields a bluish or green volatile oil containing absinthol and other principles. Absinth is added to water as a beverage, and in excess produces peculiar intoxication, and may even prove fatal.

ABÙTA (native name). *Menispermàceæ.* Greenhouse evergreen climber: plant dicœcious, fascicled or panicled: staminate fls. with 3 exterior and 3 interior larger sepals, and 6 stamens; pistillate fls. with 6 staminodia and 3 carpels: fr. a drupe; 14 species in S. Amer. Prop. by cuttings under glass with bottom heat, and grown in peaty loam. **A. ruféscens,** Aubl. Lvs. broad-ovate or suborbicular, coriaceous, brown or tawny beneath, 3-nerved: fls. small, dark purple within, the 3 large sepals obtuse. Little known in cult.

ABÙTILON (name of Arabic origin for a malvaceous plant). *Malvàceæ.* Flowering Maple. Attractive coolhouse shrubs and window-plants, and some kinds used for bedding. Sometimes called Chinese Bellflower. Fig. 65.

Leaves long-stalked, often maple-like: fls. mostly pendulous, with naked 5-cleft calyx, 5 separate obovate petals, many stamens united in a column about the many-branched style, the anthers borne at the top of the column: fr. a collection or aggregate of 2-valved often beaked carpels that are deciduous from the central axis at maturity.—Natives of warm regions in both hemispheres, comprising herbs, shrubs and trees; about 80 species.

The abutilons oftenest seen in American gardens and conservatories are apparently hybrids and derivatives of pure species. The colors are mostly yellow, white and pink, with attractive veining. Well-known forms are: Arthur Belsham, red, shaded gold. Boule de Neige, pure white, very free. California, a group of free bloomers. Eclipse, foliage marbled green, and yellow fls. of fair size; sepals scarlet; petals orange-buff; suited for baskets and vases; a form of *A. megapotamicum* (another Eclipse is known). Erecta, pink, orange-veined, erect fls. Golden Bell, deep yellow, free-flowering. Golden Fleece, pure yellow, free-flowering. Royal Scarlet, rich, shining scarlet. Santana, deep red. Savitzii, dwarf, with white-edged foliage; useful for bedding. Snowstorm, semi-dwarf, pure white. Souvenir de Bonn, lvs. large, deep green, not mottled, but edged with a broad white margin; distinct and striking; a useful bedding plant. Splendens, bright red.

64. Abrus precatorius. (×¼)

The cultivation of abutilons is simple, under conditions suitable for the growing of geraniums and fuchsias. Some of the forms are grown primarily for bloom, and they are practically continuous-flowering when well handled; the variegated-leaved forms are grown for foliage and used more or less for bedding-out. Abutilons make good pot-plants if kept within bounds by pinching back so that they will branch. *A. megapotamicum* and some others are useful for baskets and vases. The showy *A. insigne* is an excellent rafter-plant.

65. A flower of Abutilon.

Propagation is by cuttings or seeds. Cuttings may be made in spring of new wood from old plants that have been cut back, or they may be taken in fall; as the abutilon is active practically all the year, the cuttings may be taken almost at will. Seeds grow readily; if started in March, blooming plants should be had by fall. Bedding material is raised from early-struck cuttings.

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A. *Lvs. not lobed, cordate, but prominently toothed, sometimes angled.*

B. *Corolla wide open.*

1. **insígne,** Planch. (*A. igneum,* Hort.). Lvs. medium size, crenate-dentate, acuminate, villous pubescent underneath: fls. large, flaring-mouthed, under-color white but obscured by very heavy and rich veining and markings of purple and red, on slender hanging peduncles. Colombia. B.M. 4840. Gn. 18:624; 53, p. 300. F.S. 6:551.—Very showy; common. Often trained under the roof of the greenhouse or conservatory. St. green, brown-hairy.

2. **longicúspe,** Hochst. White-canescent much-branched shrub, with long-acuminate broad-cordate and blunt-toothed long-stalked lvs., felt-like below: fls. bluish purple, veiny, wide open, on mostly many-branched axillary peduncles. Abyssinia.—Intro. by S. Calif. Acclimatizing Assoc., from seed collected by Schweinfurth and distributed from Berlin in 1893.

3. **sinénse,** Oliver. Lvs. large and broadly cordate-ovate, long-acuminate, notched but not lobed, somewhat tomentose beneath: fls. large (2 in. or more across), open-bellshaped, orange-yellow with large interior veins and marks of reddish brown. Cent. China, recently intro. to cult. Seed apparently not yet in the American trade. R.H. 1909:452.

BB. *Corolla long and narrow.*

4. **megapotámicum,** St. Hil. & Naud. (*A. vexillàrium,* Morr.). Fig. 66. Drooping habit: lvs. rather small, lance-ovate, acuminate, sharp-serrate: fls. 2–3 in. long, on short drooping stalks, the long calyx bright red, the protruding petals lemon-yellow, the column of stamens conspicuously protruding. Brazil, etc. B.M. 5717. Gn. 37:274. J.H. III. 18:359.—A strikingly handsome species, particularly for baskets and vases, apparently less seen than formerly. There is a variegated-lvd. variety. Generally misspelled *mesapotamicum.* Megapotamicum means "big river," signifying here the Rio Grande.

AA. *Lvs. prominently lobed, mostly maple-like or vitis-like.*

B. *Foliage silky or tomentose, at least beneath.*

5. **Selloviànum,** Regel (*A. Selloànum,* authors, a correction of the published name, as the plant is named for Sello. *A. Sellovidnum,* Hort.). Upright, thick-hairy plant: lvs. roundish deep-heartshaped, long-stalked, 3-lobed with long-pointed parts, 7–9-nerved, unequally toothed, the under side soft silky tomentose: fls. light purple, with erect petals. Brazil. Var. **marmoràtum,** Hort., has lvs. variegated with golden yellow.—A good summer bloomer. The variegated form is sometimes used for bedding.

6. **Dárwinii,** Hook. f. (*A. Hildebrandii,* Fenzl.). Strong pubescent shrub of dwarfish habit: lvs. velvety pubescent beneath, thickish, 5–9-ribbed, the lower ones lobed to the middle, the upper ones shallow-3-lobed: fls. 1–3 in an axil on short sts., 1½–2 in. across, orange-red with blood-red veins, widely open or spreading. Brazil. B.M. 5917. Var. **tessellàtum,** Hort., has lvs. handsomely checkered with yellow.—Blooms in both winter and summer. Much hybridized with other species. *A. grandiflòrum* and *A. compáctum* are garden forms; also *A. floribúndum,* Hort., R.H. 1881:350. Gt. 23:794 (var. *trinérve,* Regel).

BB. *Foliage not tomentose or silky, glabrous or slightly pubescent.*

C. *Fls. blue (varying to white in cult.).*

7. **vitifòlium,** Presl. Lvs. cordate in general outline, 3–5-, and sometimes 7-, lobed, the lobes long-pointed: fls. open bell-shaped or cup-shaped, large, lavender-blue, more or less veined (sometimes white), clustered, anthers yellow. Chile.—A hardy species, remaining out-of-doors in S. of England; height becoming 30 ft.: lvs. golden in autumn. B.M. 4227, 7328. Gn. 51:334; 66, p. 8 (clumps); 76, p. 415. J.H. III. 62:380. B.R. 30:57.

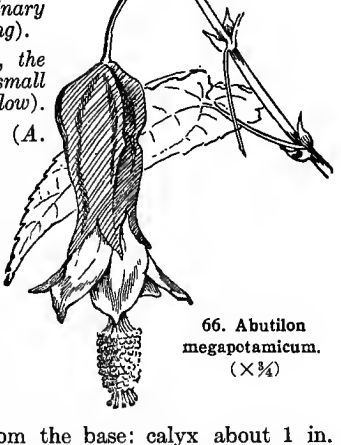
CC. *Fls. yellow or orange in ground color.*

D. *Blossoms very large: lvs. 7-lobed.*

8. **venòsum,** Lem. Very strong, tall grower: lvs. large, deeply palmately 7-lobed and strongly toothed: fls. large, 3 in. long, on sts. 10–12 in. long, bell-shaped and not flaring, golden orange, with veins and over-colors of blood-red and brown. Mex. B.M. 4463.—A showy species.

DD. *Blossoms of ordinary size (2 in. or less long).*

E. *Lf.-blades 3-lobed, the side lobes often small (or the clefts shallow).*



66. Abutilon megapotamicum. (×¾)

9. **pictum,** Walp. (*A. striàtum,* Hort., at least in part, not Dickson). Strong and hardy free-blooming species, with lvs. green or variegated and glabrous or thinly pubescent, the middle lobe usually about equaling or sometimes shorter than the undivided part of the lf. and wedge-shape or tapering from the base: calyx about 1 in. long, cleft about to its middle, brownish pubescent; corolla less than 1½ in. long, orange or yellow, veined crimson. S. Brazil to Buenos Ayres.—Has been confused with *A. striatum.*

10. **plenifl̀orum,** N.E. Br. Lvs. green, glabrous both sides, the middle lobe slightly narrowed at its base and half again as long as the undivided part of the blade: fls. double.—Perhaps of hybrid origin, with *A. pictum* a probable parent.

EE. *Lf.-blades 5–7-lobed, the middle lobe always more or less narrowed at its base.*

11. **striàtum,** Dicks. A Guatemalan species perhaps not in cult. in its original form: middle lobe of lf. usually at least twice as long as undivided part of blade and twice longer than broad, green: calyx somewhat less than 1 in. long, the lobes about twice as long as tube, brown-pubescent; corolla 1¾ in. or less long, orange, conspicuously dark crimson-veined. B.M. 3840 (as *Sida picta*).—Var. **Thómpsonii,** Veitch. Fig. 67. Lvs. variegated with yellow, not pubescent; first exhibited by Veitch & Sons in 1868; said to be from Jamaica; perhaps not in general cult. at present.—Var. **spùrium,** Lynch. Lvs. variegated with yellow, thinly pubescent above but thickly pubescent beneath with fine hairs, the calyx white-pubescent: corolla light reddish orange with redder veins; probably of garden origin.—The cult. forms of this species-group are imperfectly understood, particularly those passing as *A. Thompsonii.* In England, the form usually known as *A. Thompsonii,* and used for bedding, is the var. *spurium.* In N. Amer. several different things are called *A. Thompsonii,* some of them not variegated and at least one of the variegated forms having double fls. The Fig. 67 is inserted to distinguish the plant originally distributed as *A. Thompsonii,* and to which the name should be restricted. Probably some of the *A. Thompsonii* forms belong in the general *A. hybridum* group.

67. Abutilon Thompsonii as originally pictured in Florist and Pomologist, 1869, p. 21. Inserted to show the plant to which the name Thompsonii should be applied.

The confusion between the Brazilian *A. pictum* and the Guatemalan *A. striatum* is reduced by N. E. Brown, G. C. 1910 (2) pp. 427 and 488.

12. **hȳbridum,** Hort. Under this name have been placed the many garden forms and hybrids, most of which have many of the features of the *A. striatum* group. *A. Darwinii* has been one of the parents in some of them, as in *A. rosæflorum,* and Golden Fleece (Gn. 53:300), both of which are recorded as offspring of

Darwinii and Boule de Neige. Other varieties referable here are Fireball, Golden Bell, Gold Ball, Savitzii, Souvenir de Bonn, Caprice, Boule de Neige (Snowball). Fig. 68 shows one of the forms of this garden group, passing sometimes erroneously as *A. Thompsonii.*

A. arbòreum, Sweet. Lvs. cordate, tomentose: fls. pale yellow. Peru.—*A. Bedfordiànum,* St. Hil. Lvs. lobed: fls. yellow with red: very tall. Brazil.—*A. esculéntum,* St. Hil. Lvs. cordate, acuminate, toothed, tomentose: fls. purple, solitary. Fls. said to be cooked and eaten by natives in Brazil under name of Bencaode Deos.—*A. globiflòrum,* Don. Fls. large, cream-colored. Mauritius. —*A. integérrimum,* Hook. & Jackson, Index Kewensis. (Sida integerrima, Hook. B.M. 4360.) Lvs. entire, cordate, tomentose below: fls. large, yellow, flaring. Colombia.—*A. pæoniæflòrum,* Walp. Fls. rather small pink. Brazil.—*A. pulchéllum,* Swest, and *A. pùlchrum,* Don. =Plagianthus pulchellus. L. H. B.

ACACÁLLIS: *Aganisia.*

ACÀCIA (from word meaning a *point* or *thorn,* referring to the stipules often spinescent). *Leguminòsæ,* tribe *Mimòseæ.* Trees or shrubs grown out-of-doors in warmer parts of the United States and some of the species as cool greenhouse plants for the showy yellow bloom.

Leaves bipinnate or reduced to phyllodia with vertical edges (i.e., lf.-like petioles): fls. regular, orange-yellow, occasionally lemon-yellow or white, in cylindrical spikes or globular heads, solitary, or in pairs or clusters, or in axillary racemes; sepals and petals 5, 4 or 3, free or united; stamens many, long: pod a legume, opening by two valves (occasionally indehiscent): funicle of the seed filiform or ending in club-shaped aril, either twice encircling the seed or simply bent back upon itself. (The difference between Acacia and Albizzia lies in the stamens, which are free in the former and united at base in the latter.) A very large genus (said to be 450 species) dispersed throughout the tropical parts of the earth and even pushing their way into parts of the temperate zones. The phyllodine series is confined almost entirely to Australia and the Pacific Isls., while the bipinnate series is scattered over the warm parts of the remainder of the globe. The number of species reported from Amer. is large (about 70), of which at least 30 are Mexican. Acacias are said to be natives of the following states: Ariz., Ark., Calif., Fla., Okla., Kan., La., Mo., Nev., New Mex. and Texas. Those in the following account are Australian, unless otherwise stated. This list will undoubtedly be modified as botanists segregate the other genera from the Mimoseæ group. Acacias vary greatly under cult., the variation affecting infl., size and shape of lf., and even the funicle. One should not expect to determine an unfamiliar species without lvs., fls. and fr., with its seeds in place.

Other species interesting because of their ant-inhabited thorns are described under *Bull-horn Acacias.* Other species referred to Acacia are to be found under *Albizzia.*

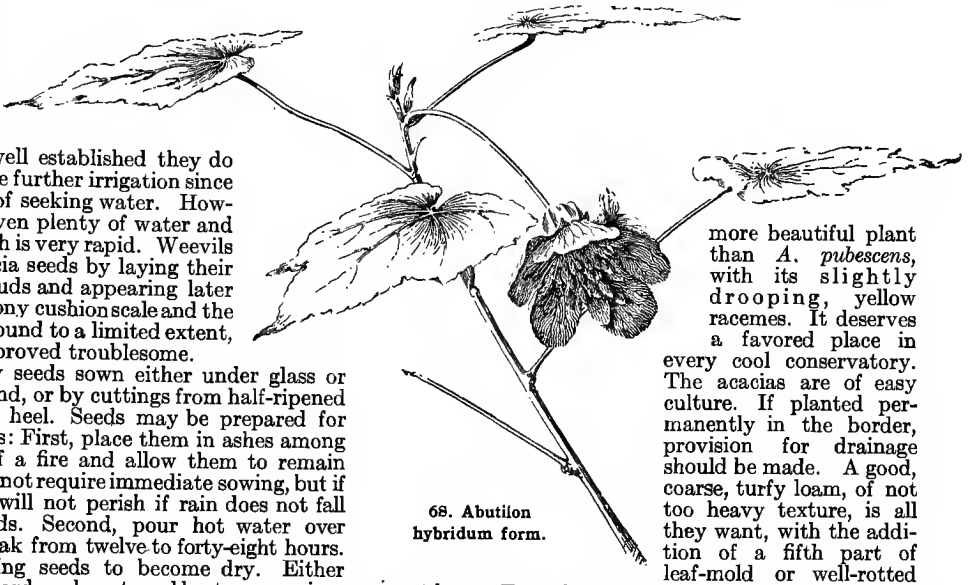
Acacias are quick-growing plants and are short-lived. Various kinds have been known to grow from 11 to 12 feet in four months and 25 feet in six years. These trees are thus in their full maturity at thirty years of age, and shortly afterward begin to deteriorate. While they may thus be used as street trees to secure immediate effects, more permanent trees should also be planted to take their places. The leaves of some species are used in cookery, the flowers of *A. Farnesiana* for perfumery, the bark of various species for tanning; *A. Senegal* furnishes most of the gum arabic of commerce; a drug or medicine is made from the wood of *A. Catechu;* a soap or hair-wash from *A. concinna;* several are used as forage plants, others for dyes, and still others for fiber. Many of them have scented wood, others make fine furniture wood, and are used for cabinetwork and fence-posts or fuel, still others for street trees (as *A. melanoxylon* and *A. dealbata*), and all are more or less ornamental. The Ark of the Covenant, as well as the furniture of the Tabernacle, are said to have been made

from timber of *A. Seyal*, which yields the Shittim wood of the Bible. Also on account of its incorruptible wood, this species for ages was used by the Egyptians to make coffins for the burial of their kings.

Acacias out-of-doors will not endure much frost. They seem to thrive very well in localities in which the winter temperature is as low as 20° F., or even 18°, and it is to be hoped that by careful selection strains may be secured that will withstand an even lower temperature. Some species are alkali-resistant as *A. cyclops*, *A. retinodes* and perhaps others. After the trees are once well established they do not ordinarily require further irrigation since they have a faculty of seeking water. However, if they are given plenty of water and good soil their growth is very rapid. Weevils sometimes ruin acacia seeds by laying their eggs in the flower-buds and appearing later in the pod. The cottony cushion scale and the black scale are also found to a limited extent, but so far have not proved troublesome.

Propagation is by seeds sown either under glass or out in the open ground, or by cuttings from half-ripened wood, taken with a heel. Seeds may be prepared for planting in two ways: First, place them in ashes among the dying embers of a fire and allow them to remain until cool. These do not require immediate sowing, but if they are sown they will not perish if rain does not fall very soon afterwards. Second, pour hot water over seed, let cool and soak from twelve to forty-eight hours. Sow without allowing seeds to become dry. Either method softens the hard seed-coats and hastens germination. They will then usually germinate in about seven days to three or four weeks, depending upon the species and the season in which they are sown. Seed may be sown in the propagating-house at any time throughout the year, though early spring is the natural time. For open ground, sow in March or April. After germination, the plants are pricked off into flats or pots and shifted into larger ones as occasion requires. They are thus kept in pots until they are ready to be transplanted to their permanent quarters, since if placed in the open ground at once the tap-roots will grow with too great rapidity and the tree will either have to be balled or transplanted with the greatest care to prevent its receiving a shock, from which it will take at least a year to recover. When buying seedlings from a nursery, therefore, reject all those whose roots have penetrated the pot. While several species (*A. pycnantha*, *A. melanoxylon*, *A. decurrens* var. *dealbata*, etc.) have been known to resow themselves in California, there is no danger of their becoming a pest (such as *A. armata* in Australia), since the seedlings are seldom able to live through the dry season without irrigation. Cuttings should be made from the half-ripened wood, of which the best are from the side shoots of the main stem, taken with a heel. No bottom heat is required, or very little, but they should be covered with a light frame and kept moist and cool by shading. They root slowly but freely and should be potted immediately after rooting, but should not be planted in the open soil until they have developed good roots.

Cultivation in greenhouses as florists' plants is confined to few species, perhaps not more than a dozen being commercially valuable. All of this most important section thrive in a winter temperature ranging from 40° to 50°; in fact, little above the freezing point is sufficient. They do not like heat, and consequently are not adapted for forcing. If wintered cool and allowed to come along naturally with the increasing heat and light of the spring, they will flower in March and April, a season when their graceful beauty is appreciated in the private conservatory or is valuable to the commercial florist. The prevailing color of all the Australian species is yellow, varying from pale lemon to deep orange. The tall-growing kinds, or rather those inclined to make long, straight shoots, make excellent subjects for planting permanently against a glass partition of a conservatory, or against a pillar. There is scarcely a more beautiful plant than *A. pubescens*, with its slightly drooping, yellow racemes. It deserves a favored place in every cool conservatory. The acacias are of easy culture. If planted permanently in the border, provision for drainage should be made. A good, coarse, turfy loam, of not too heavy texture, is all they want, with the addition of a fifth part of leaf-mold or well-rotted spent hops. Few of our greenhouse pests trouble them. Water in abundance they like at all times, and in their growing season, which is the early summer months, a daily syringing is necessary. Several of the species of bushy habit are very much grown as pot-plants in Europe, and are now largely imported and sold for the eastern trade. *A. armata* and *A. Drummondii* are good species for this purpose. With our hot summers, the commercial man will do better to import than to attempt to grow them from cuttings. The acacias need pruning, or they will soon grow straggling and unshapely; more especially is this true of those grown in pots. After flowering, cut back the leading shoots rather severely. Shift into a larger pot if roots demand it, and encourage growth by a genial heat and syringing, giving at same time abundance of light and air. They should be plunged out-of-doors as soon as danger of frost is past, and removed to the greenhouse before any danger of early fall frosts. Cuttings root surely but not quickly. The best material is the side shoots from a main stem in the condition that florists call half-ripened —that is, not green and succulent as for a verbena, nor as firm and hard as the wood of a hybrid perpetual rose in November. The wood or shoot will be in about the right condition in June. No bottom heat is needed, but the cuttings should be covered with a close frame and kept moderately moist and cool by shading. The following spring these young plants can be either planted out-of-doors, where there is a good chance to keep them well watered, or grown on in pots, as described above. A few of the finest species are *A. pubescens*, suitable for training on pillars; *A. Riceana* makes a bush or can be trained; *A. longifolia*, an erect species, deserves a permanent position in the greenhouse border. Of all the species best adapted for medium-sized, compact pot-plants, *A. armata* and *A. Drummondii* are the best. The former has small, simple, dark green leaves and globular, pure yellow flowers. *A. Drummondii* has drooping, cylindrical, pale lemon flowers. As both these flower in March without any forcing in our northern greenhouses,



68. Abutilon hybridum form.

they are very valuable acquisitions to our Easter plants. The acacia has two distinctive charms: the foliage is either small, simple and glaucous, as in *A. armata*, or much divided, graceful and fern-like, as in *A. pubescens*. All the acacias are among the freest-flowering of our hard-wooded plants. (William Scott.)

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KEY TO THE SPECIES.

A. *Lvs. reduced to phyll. (i. e., the petiole is flattened to resemble a simple lf.).*
B. *Fls. in globular heads.*
C. *Phyll. terete or slightly flattened.*
D. *The phyll. tapering into points.*
E. *Funicle filiform to its end*.... **1. juniperina**
EE. *Funicle ending in enlarged aril.*
F. *Fls. cream-yellow; phyll. slender, broad at base.* ... **2. tenuifolia**
FF. *Fls. rich yellow: phyll. thick, narrower at base*..... **3. diffusa**
DD. *The phyll. with innocuous points, not pungent.*
E. *Peduncle usually more than 1-headed*..... **4. calamifolia**
EE. *Peduncle mostly 1-headed.*
F. *Phyll. obscurely nerved*..... **5. juncifolia**
FF. *Phyll. prominently nerved, st. almost winged*..... **6. extensa**
CC. *Phyll. vertically flattened.*
D. *Veins of phyll. 1, or very rarely 2.*
E. *Fl.-heads solitary or in pairs or clusters.*
F. *Length of phyll. 1 in. or less.*
G. *Stipules persistent as slender spines.*
H. *Pods hirsute.*
I. *Phyll. semiovate*..... **7. armata**
II. *Phyll. wedge-shaped*.. **8. cuneata**
HH. *Pod glabrous: phyll. triangular or rhomboidal*..... **9. decipiens**
GG. *Stipules deciduous, small or none.*
H. *Peduncles shorter than phyll*.....**10. Meissneri**
HH. *Peduncles longer than phyll.*
I. *Nerve near one edge: phyll. 1½ in. wide*... **11. lineata**
II. *Nerve central: phyll. over 1½ in. wide.*
J. *Phyll. orbicular*...**12. obliqua**
JJ. *Phyll. oblong*.....**13. acinacea**
FF. *Length of phyll. 1¼–4 in.*
G. *More or less spinescent*...**21. sentis**
GG. *Not spinescent*.....**14. dodonæifolia**
EE. *Fl.-heads in axillary racemes (rarely reduced to a solitary head).*
F. *Length of phyll. 2 in. or less.*
G. *Racemes much exceeding phyll.*
H. *Phyll. hoary or pubescent*.....**15. podalyriæfolia**
HH. *Phyll. glabrous.*
I. *The phyll. nearly as broad as long.*
J. *Shape of phyll. obliquely ovate*..**16. cultriformis**
JJ. *Shape of phyll. triangular*.....**17. pravissima**
II. *The phyll. oblong-falcate, not so broad as long*.....**18. lunata**
GG. *Racemes not or only slightly exceeding phyll. (except A. linifolia var. prominens).*
H. *Phyll. obliquely obovate.***19. hrachybotrya**
HH. *Phyll. lanceolate (often 3 in. long in Calif.)*..**20. myrtifolia**
HHH. *Phyll. linear.*
I. *Stipules spinescent*...**21. sentis**
II. *Stipules not spinescent.*
J. *Gland at base*.....**22. linifolia**
JJ. *Gland below middle* **22. linifolia** var. [prominens
FF. *Length of phyll. over 2 in. (except A. salicina var. Wayæ).*
G. *Some of phyll. over 1 in. wide.*
H. *Funicle encircling seed and bent back in double fold.*
I. *Pod ¼ in. wide*.....**23. falcata**
II. *Pod over ¼ in., nearly ½ in. wide*.....**24. penninervis**
HH. *Funicle not encircling seed.*
I. *Phyll. sickle-shape*...**25. pycnantha**
II. *Phyll. not sickle-shape.***26. saligna**
27. cyanophylla
GG. *All phyll. under 1 in. wide.*
H. *Phyll. linear-lanceolate, mostly widest above middle.*
I. *Midrib much to one side, gland one-third from base, making a notch*....**28. obtusata**
II. *Midrib central or nearly so, gland ¼–½ in. from base.*
J. *Funicle surrounding seed*.....**29. retinodes**
JJ. *Funicle not surrounding seed*...**30. neriifolia**
HH. *Phyll. linear-oblong, not widest above middle.*
I. *Seeds nearly transverse*.....**31. suaveolens**
II. *Seeds longitudinal.*
J. *Racemes compound***32. macradenia**
JJ. *Racemes simple, often reduced to 2 or 3 heads.*
K. *Foliage pale*....**33. salicina**
KK. *Foliage dark green*.....**33. salicina var.** [Wayæ
DD. *Veins of phyll. several (rarely only 2), longitudinal.*
E. *Fl.-heads in racemes.*
F. *Phyll. 2-nerved*.....**34. binervata**
FF. *Phyll. more than 2-nerved.*
G. *Pod with narrow wing*...**35. pendula**
GG. *Pod not winged.*
H. *Funicle encircling seed in double fold*.....**36. melanoxylon**

HH. *Funicle folded at end of seed, not encircling it.*
I. *Width of pod ¼in.*....37. **implexa**
II. *Width of pod ¾–1 in.* 38. **koa**
EE. *Fl.-heads solitary or in pairs or clusters.*
F. *Width of phyll. 1/16in. or less, linear.*
G. *Phyll. viscid.*....39. **viscidula**
GG. *Phyll. not viscid.*....40. **elongata**
FF. *Width of phyll. over 1/16in., not linear.*
G. *The fl.-heads sessile, or nearly so.*....41. **Oswaldi**
GG. *The fl.-heads not sessile.*
H. *Funicle short, half as long as seed.*....42. **barpophylla**
HH. *Funicle long, scarlet, encircling seed in double fold.*....43. **cyclops**
BB. *Fls. in spikes.*
C. *Shape of phyll. narrow (½ to less than ¼in.), pungent pointed.*
D. *Nerves 3 or 4: phyll. scattered.*....44. **oxycedrus**
DD. *Nerves 1.*
E. *Phyll. whorled.*....45. **verticillata**
EE. *Phyll. clustered: fls. mostly 3-merous*....46. **Riceana**
CC. *Shape of phyll. broader (except A. aneura and A. longiflora var. floribunda), less rigid, not pungent pointed.*
D. *Pod winged.*....47. **aneura**
DD. *Pod not winged.*
E. *Calyx and phyll. pubescent (A. Maidenii only slightly so).*
F. *Sepals velvet-like, bright orange-yellow.*....48. **glaucescens**
FF. *Sepals not velvet-like yet more or less pubescent.*
G. *Funicle encircling seed.*....49. **Maidenii**
GG. *Funicle folded and enlarged into cup-shaped aril*....50. **holosericea**
EE. *Calyx and phyll. not pubescent.*
F. *Phyll. linear.*....51. **linearis**
FF. *Phyll. elliptical, lanceolate.*
G. *Width of phyll. over ¼in.*..52. **longifolia**
GG. *Width of phyll. less than ¼in.*....52. **longifolia**
AA. *Lvs. all bipinnate.* [var. **floribunda**
B. *Fls. in globular heads.*
C. *Stipules none or brown and scarious.*
D. *Pinnæ few, 2–10 pairs.*
E. *Rachis hirsute.*....53. **pubescens**
EE. *Rachis not hirsute.*
F. *Lfts. 1¼–1½ in. long.*....54. **elata**
FF. *Lfts. less than 1¼ in. long.*
G. *Length of pinnæ 1 in.*....55. **Baileyana**
GG. *Length of pinnæ over 1 in.*
H. *Funicle filiform.*....56. **discolor**
HH. *Funicle cup-shaped aril.*57. **pruinosa**
DD. *Pinnæ many, 8–25 pairs.*
E. *Plant a tree: lfts. 30–40 pairs, more or less tomentose-pubescent.*....58. **decurrens**
F. *Lfts. dark green, shining above, imbricate: fls. bloom in June, pale yellow.*....58. **decurrens**
FF. *Lfts. more or less gray, farther apart: fls. bloom in Jan. and Feb., deep yellow.*58. **decurrens** [**mollis**
FFF. *Lfts. light green, distant: sepals as long as petals*....58. **normalis** [**dealbata**
EE. *Plant a shrub: lfts. 20–50 pairs, glabrous.*....59. **filicina**
CC. *Stipules spinescent.*
D. *Pinnæ 1 pair.*....60. **pulchella**
DD. *Pinnæ more than 1 pair.*
E. *Pod round.*....61. **Farnesiana**
62. **Cavenia**
EE. *Pod moniliform.*....63. **arabica**
EEE. *Pod not moniliform.*....64. **eburnea**
BB. *Fls. in spikes.*
C. *Pinnæ 10–40 pairs.*....65. **Catechu**
CC. *Pinnæ 2–4 pairs.*
D. *Pod not exceeding 1 in. long*....66. **Drummondii**
DD. *Pod 1½–4 in. long.*....67. **Greggii**

1. **juniperìna,** Willd. (*A. echínula,* DC. *A. púngens,* Spreng.). A stiff shrub, 8 to 12 ft., with branchlets either pubescent or smooth: phyll. scattered, numerous and tapering into a sharp point, ⅓ to rarely ½in. long, 1-nerved: fl.-heads solitary on peduncles longer than the phyll., 5-merous; petals ciliate; petals acute, with prominent midrib: pod more or less falcate, flat, 1–2 in. long, about 1/6in. broad, usually contracted between the seeds; seeds longitudinal, the funicle but little folded and filiform to the end. May, June.—May be distinguished from *A. tenuifolia* by its funicle filiform the entire length, its petals with prominent midrib, and its 5-merous fls.

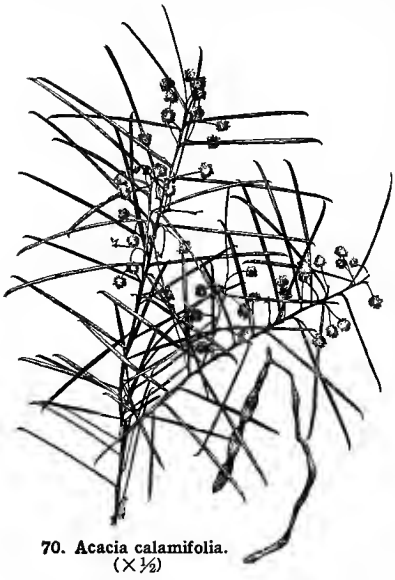
2. **tenuifòlia,** F. v. M. Fig. 69. An everblooming shrub with a sticky exudation on sts. and over the young fl.-buds: branchlets slender and drooping: phyll. linear-subulate, ¾–1 in. long, ⅛in. wide, 1-nerved, ending in a pungent point; gland at base: fls. lemon-yellow, with peduncles ¼in. long, solitary in axils of the phyll., 30 or more in a head: pods straight, slightly constricted between seeds, 2–3 in. long, nearly ¼in. wide, pointed at both ends and bearing two rough longitudinal marks over each seed, characteristic of this species; funicle silvery white, half as long as seed and enlarged into a cup-shaped aril over one end; ripe June–Nov. Fls. every month. F. v. M. Icon. 1:8.—This attractive shrub is easily grown from seed, germinating in about three weeks and growing steadily. It is delightful for situations that demand a low-branching habit. Its everblooming fls., honey-like odor and dust-resistant qualities also recommend it.

69. Acacia tenuifolia. (×½)

3. **diffùsa,** Lindl. (*A. genistæfòlia,* Link). A shrub of 5 or 6 ft. with loosely scattered foliage: phyll. linear or subulate, ½–1¼ in. long (mostly ¾in.), 1/12–⅛in. wide, 1-nerved, ending in sharp point: fls. in pairs or reduced to a single head, either 4- or 5-merous; peduncles ¼in. long; sepals not half length of petals: pod stipitate, flat, acute, 3–4 in. long, 1/6in. broad, valves convex over seeds; funicle much folded and thickened from the middle. Apr., May. B.M. 2417. B.R. 634. Var. **cuspidàta,** Benth. (*A. cuspidàta,* Cunn.). Phyll. more slender, from ¾–2 in. long, about as broad as thick.

4. **calamifòlia,** Sweet. Broom Wattle. Fig. 70. A tall shrub or small tree with slender erect branches: phyll. narrow-linear to subulate, with oblique point at apex and narrowed to base, 1½–2¼ in. long, 1/16in. wide, 1-nerved; gland near base (obscure in dried specimens): racemes short, of 3 or 4 heads, or reduced to a single one; fls. 20 to a head, 5-merous; sepals half as long as petals; peduncles ¼in. long: pods a rich brown, slightly contracted between the seeds, 1¼–3 in. long, 3/16in. wide; funicle red, almost encircling the seed in a double fold, ending in a silvery club-shaped aril; ripe Aug. Fls. Feb.–Apr. B.R. 839.—An attractive ornamental at all times but especially so when in full bloom. An excellent tan-bark species, analysis showing as much as 20.63 per cent of tannin.

5. **juncifòlia**, Benth. (*A. pinifòlia*, Benth.). A tall shrub with terete branches, either glabrous or hirsute: phyll. from slightly flattened to tetragonous, 3–6 in. long or more, with a nerve on each side: fls. 5-merous, either solitary or in pairs, about 40 in a head; petals united; calyx spatulate and ciliate, not half so long as petals; peduncles ¼in. long (rarely ½in.): pod flat, with nerve-like margins, 3–4 in. long, less than ¼in. wide; seeds oblong, longitudinal; funicle half as long as seed, filiform but slightly thickened at hilum. F. v. M. Icon. 2:8.



70. Acacia calamifolia. (×½)

6. **exténsa**, Lindl. (*A. pentàedra*, Regel). A shrub 5 ft. tall, with more or less winged angular branchlets: phyll. linear-subulate or needle-like, 3–4 in. long (sometimes 8), $\frac{1}{24}$in. wide, 1-nerved, ending in sharp point; gland ½–1 in. from base: fls. solitary or shortly racemose, 20 in a head, 5-merous; sepals short; peduncles ¼in. long: pods with nerve-like margins, constricted between the seeds, 2–4 in. long, ¼in. wide; funicle straight and only slightly thickened at hilum end; ripe May. Fls. March.

7. **armàta**, R. Br. (*A. undulàta*, Willd. *A. paradóxa*, DC. *A. furcífera*, Lindl. *Mimòsa paradóxa*, Poir.). Kangaroo Thorn. Fig. 71. A spreading shrub 8–10 ft. wide, 7–11 ft. tall, with pendent finger-like branchlets: phyll. half-ovate, the straight edge hugging the st., the other edge more or less undulate; nerve excentric, ending in a pungent point; stipules reduced to slender spines about ¼in. in length: fls. solitary on peduncles ¾in. long; petals 5; sepals 5, more than one-half length of corolla: pods hairy, straight or slightly curled, in clusters of 2–5 or reduced to 1, 1½–2 in. long, $\frac{3}{16}$in. wide; funicle silvery, as long as seed and enlarged to a cup-shaped aril; ripe Aug. Fls. Feb.–Apr. B.M. 1653.—A shrub with breadth often much greater than its height, sometimes 15–20 ft. across, hence suitable for large grounds and roomy corners. Makes a good hedge plant, and is also used to reclaim sand-dunes. It is a good rich green and withstands considerable dust and drought. There is a larger-lvd. form with fissured bark and more straggling habit. The phyll. is greener and more tender in texture than the type, and the fls. are larger.

8. **cuneàta**, Benth. A tall glabrous shrub: phyll. ½ to scarcely 1 in. long, wedge-shaped, truncate at the apex, nerve excentric, ending in sharp point at one angle while the other angle is tipped by a gland; occasionally a faint secondary nerve; stipules setaceous: fls. solitary; peduncles about as long as phyll., 8–15 in a head, 4-merous; petals separate; calyx turbinate, half as long as corolla and with broad lobes: pod hirsute, thick margins, 2–3 in. long and $\frac{1}{16}$in. wide. B.R. 1839.—An interesting ornamental species, somewhat resembling *A. pravissima*.

9. **decípiens**, R. Br. (*A. dolabrifórmis*, Colla. *A. incrassàta*, Hook. *A. biflòra*, Paxt.). A shrub either low and bushy or up to 10 or 12 ft. tall, glabrous or rarely hirsute: phyll. triangular or trapezoid, ⅓–⅔in. long and nearly as broad; principal nerve excentric, ending in small point, gland on other angle; the occasional stipules are spinescent: fls. solitary or in pairs, 6–10 in a head: pod thick, hard, much incurved, 1–2 in. long, $\frac{1}{12}$–⅛ in. wide, narrowed at each end; seeds longitudinal; funicle ending in club-shaped aril. B.M. 1745, 3244.—The difference between this and *A. cuneata* seems to lie chiefly in fls. and phyll., which are about as broad as long in *A. decipiens*, and much longer than broad in *A. cuneata*, and wedge-shaped.

10. **Meìssneri**, Lehm. Tall shrub: young branches glabrous, acutely angular: phyll. ½–1 in. long, $\frac{1}{16}$–⅛in. broad, obovate-oblong or obliquely cuneate, obtuse, or with a small, hooked point: peduncles shorter than the phyll.: pod flat, ¼–⅓in. broad, the margins not thickened; seed oblong, longitudinal; funicle very long and much folded, the last fold almost encircling the seed and returning, but thickened only at the end.

11. **lineàta**, A. Cunn. (*A. runcifórmis*, A. Cunn.): A bushy shrub: branches usually pubescent, terete and often slightly resinous: phyll. linear, ½–¾in. long or more, 1½ in. wide, nerve near the margin and ending in small hooked point: fls. solitary, 5-merous, equal to or exceeding the phyll.; sepals distinct, linear-spathulate; peduncles ¼–½in. long: pod curved or twisted, $\frac{1}{16}$in. wide; funicle not so long as seed, ending in a clavate fleshy aril. Fls. March. B.M. 3346 (as *A. runciformis*). —This differs from *A. acinacea* and *A. obliqua* in only its narrow phyllodia. Habitat in barren forest grounds in the interior of New South Wales.

12. **oblìqua**, Cunn. (*A. rotundifòlia*, Hook.). A drooping shrub, with finger-like branches, angular and slightly pubescent: phyll. obliquely obovate to orbicular, ¼–½in. long, ¼–⅜in. wide; 1 excentric nerve ending in recurved point; stipules minute; gland, when present, one-third distant from base: fls. 5-merous, solitary or in pairs on peduncles ½in. long; fls. 15–20 in a head; petals with midrib; sepals narrow, half as long as petals: pod more or less twisted and constricted between the seeds, 1–2 in. long, $\frac{1}{16}$in. wide, thin, with nerve-like margins; funicle club-shaped, half as long as seed; ripe July, Aug. Fls. Feb. B.M. 4041.

71. Acacia armata. (×½)

13. **acinàcea**, Lindl. (*A. Latròbei*, Meisn.). A much-branched shrub: phyll. obliquely oblong, ½–¾in. long, ¼–½in. wide, obtuse, with a recurved point; gland one-third distance from base: fls. in pairs (rarely solitary), 5-merous; calyx spathulate, ciliate, half as long as petals; petals united; peduncles ½–¾in. long: pod twisted or curved, $\frac{1}{16}$in. wide, more or less constricted between the seeds; seed longitudinal; funicle not so long as seed and thickened into fleshy clavate aril. Fls. March. F. v. M. Icon. 4:7.—F. v. Mueller proposed to unite this with the broad-lvd. *A. obliqua*, since the only difference between them seems to be based upon shape of phyll. This group should be given further study to determine whether transition stages may be found between the narrow and the round forms and whether

the supposed distinction of straight pods in *A. acinacea* can be traced into the curled pods of *A. obliqua*.

14. **dodonæifòlia,** Willd. A tall, glabrous, very resinous shrub: phyll. lanceolate to linear-falcate, tapering to base, having the appearance of being encrusted with a brownish powder, 1½–2, sometimes 4, in. long, about ¼in. wide, the lateral veins prominent and anastomosing; 1 central nerve ending in an oblique point: fls. solitary or in pairs, not exceeding the phyll.; peduncles ½in. long; about 40 fls. in a head, 5-merous; calyx more than half as long as corolla: pod straight or falcate, about ¼in. wide; seeds longitudinal; funicle with last 2 or 3 folds dilated into an irregular cup-shaped aril. March.—Superficially this resembles the *A. retinodes* group, but the fls. are solitary or in pairs instead of in racemes, and it has an apparent incrustation on foliage.

15. **podalyriæfòlia,** Cunn. (*A. Fràseri,* Hook. *A. Calèyi,* Cunn.). Fig. 72. A tall, glabrous shrub with conspicuous gray branchlets covered with a soft pubescence: phyll. pinniveined, pubescent (rarely glabrous), ovate or oblong, 1–1½ in. long, ½–1¼ in. wide, nerve-like margins and prominent excentric midrib ending in oblique point, the margins and midrib ciliate; gland at middle or just below: racemes simple, longer than phyll., of numerous small heads; calyx turbinate, not half so long as corolla; petals hirsute, with prominent midrib: pod flat, either glabrous or pubescent, 1–3, or more, in. long, ¾in. broad; seeds longitudinal; funicle not encircling seed but in short folds at hilum end, the last fold slightly thickened. R.B. 33:105. G.C. III. 43:11. Gt. 54:1541. G.W. 9, p. 158.—Its neat gray ovate lvs. and abundant long yellow racemes at the end of the branches make it a very decorative and popular species.

16. **cultrifórmis,** Cunn. (*A. cultràta,* Ait.). A tall shrub with gray foliage thickly clothing the branches: phyll. with nerve-like margins, obliquely ovate to almost triangular, ½–1 in. long, ¼–½in. wide, with gland on upper edge one-third distance from base, the intervening edge straight and closely hugging the branchlets; vein excentric, much curved, ending in mucronate point: racemes axillary, much exceeding the phyll.; fls. 30–40 in a head; sepals half as long as petals; peduncles ¼in. long: pod a rich brown, with nerve-like margins, 1½–3 in. long, ¼in. wide, occasionally constricted between the seed; seed oblong, longitudinal; funicle half as long as seed, silvery and enlarged into a cup-shaped aril almost from the beginning; ripe Sept., Oct. Fls. March, Apr. R.H. 1896, p. 503. J.H. III. 34:131.—If kept well pruned it makes a good hedge. Has been cult. in Calif. for many years in the open, and is considered a desirable plant.

17. **pravíssima,** F. v. M. Fig. 72. A small tree, 15–20 ft. high with decurrent, pendulous, finger-like branchlets thickly clothed with short foliage: phyll. ¼–1 in. long, ¼–½in. broad, cuneiform to trapezoid, one angle rounded, the other acute, indistinctly 2-nerved, the prominent nerve excentric and ending in a mucronate point; gland large, near middle of upper edge: racemes much longer than phyll., 10 to more fls. in a head; peduncles $\frac{1}{16}$in. long: pods, when ripe, once or twice twisted, with nerve-like margins and mucronate tip, 1½–2¾ in. long, ¼in. wide; seed small, longitudinal, with prominent central marking; funicle as long as seed, enlarged into club-shaped aril; ripe July, Aug. Fls. Feb., March.—A very graceful showy species that is becoming popular.

18. **lunàta,** Sieb. (*A. oleæfòlia,* Cunn.). A glabrous shrub with angular branches: phyll. oblong-falcate, obtuse, with sharp point, ¾–1 in. long, ¼–½in. wide; vein excentric; gland one-third distance from base: racemes simple, longer than phyll.; fls. 4–15 in a head; calyx united, about one-third length of corolla: pod straight or curved, ⅓in. wide, seeds longitudinal, near upper suture, the last fold of the funicle thickened into a lateral club-shaped aril, the lower folds very small. Apr. B.R. 1352.—This resembles *A. linifolia* var. *prominens* in fls. and foliage; the fr. is necessary to distinguish them.

19. **brachybòtrya,** Benth. Tall shrub: phyll. ½–1¾ in., rarely, in luxuriant specimens, 2 in. long, obliquely obovate or oblong, firm, rather broad, obtuse or mucronulate: fl.-heads few, short, axillary racemes, about equaling the phyll., or rarely reduced to 1 head; fls. 20–50 in a head: pod flat, linear to narrow-elliptical.

Var. **argyrophýlla,** Benth. (*A. argyrophýlla,* Hook.). Silvery-silky, turning sometimes golden yellow: phyll. mostly ¾–1½ in. long: fl.-heads often solitary. B.M. 4384.

Var. **glaucophýlla,** Benth. Glaucous and more or less pubescent: phyll. mostly ½–¾in. long: fl.-heads mostly 2–5, shortly racemose.

Var. **glàbra,** Benth. Quite glabrous: phyll. small and narrow: fl.-heads small.

20. **myrtifòlia,** Willd. A tall shrub with angular branchlets, the angles, glands and margins of phyll. edged with light red or pink: phyll. oval to ovate-lanceolate, the apex either acute with oblique point or obtuse and rounded, 1¼–2 in. long, ⅓–½in. wide; gland ¼in. from base; nerve excentric: fls. in racemes nearly as long as phyll.; peduncles ⅛in. long; fl.-heads few (3–5), though large, 4-merous; petals with prominent midrib; sepals short, united: pod with nerve-like margins, curved and contracted between the seeds and tough, 3 in. long, ⅛in. broad; funicle short, thickened into cup-shaped aril. B.M. 302. Fls. Feb–Mar.

Var. **celastrifòlia,** Benth. (*A. celastrifòlia,* Benth.). Phyll. mostly 1½ in. long and often 1 in. broad. B.M. 4306.

Var. **normàlis,** Benth. Phyll. mostly 1–2 in. long and about ½in. broad.

Var. **angustifòlia,** Benth. Phyll. mostly 2-4 in. long, $\frac{1}{16}$–⅛in. broad.

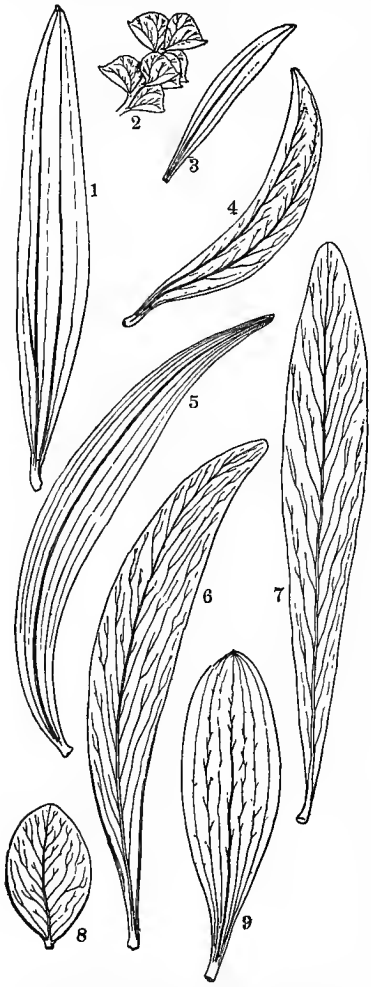
21. **séntis,** F. v. M. A rigid shrub or small tree 30 or 40 ft. high, with terete branchlets and when young either glabrous or pubescent: phyll. various, either lanceolate-oblong with a short point or linear with a hooked point, in some specimens ¾in. long by ⅛ or ¼in. broad and in others again they may be 2 in. long and $\frac{1}{12}$in. broad; marginal gland near base or wanting; stipules reduced to spines, occasionally none: fls. solitary or in pairs or racemes, 20–30 fls. in a head; sepals linear, spatulate, ciliate: pod flat, 2–3 in. long, ½–¾in. broad; seeds nearly oblique, the funicle gradually thickened and folded several times, fitting against seed like a cap. May. F. v. M. Icon. 4:9.—A desert species commonly growing in sandy soil. It thrives with scant rainfall but requires much light, although in its native country it is now and then found among large trees. It is a valuable fodder plant, cattle eating it greedily. A specimen in Calif. was growing on soil that was almost rock and consequently became shallow-rooted. The wind threw it down repeatedly but each time when set in place it continued its growth, apparently unharmed. In New S. Wales it is said that the presence of this tree is a sure indication of underground water. Its roots have been found 80 ft. from the surface.

22. **linifòlia,** Willd. A tall shrub with a minute pubescence on the branchlets and at the base of the young phyll.: phyll. linear on young shoots to linear-lanceolate on more mature ones, ¾–1½ in. long, $\frac{1}{16}$–⅛in. wide, 1-nerved, ending in mucronate point; gland below the middle small: racemes shorter than phyll., with 8–12 fls. in a head: pod flat, with nerve-like margins, 2½–4 in. long, ⅜in. wide; funicle half as long as seed, with club-shaped aril. B.M. 2168.

Var. **prôminens,** Moore (*A. prôminens,* Cunn.). Phyll. wider, oblong-lanceolate, 1–1½ in. long, ⅛–⅜in.

wide; very prominent gland, its position varying, sometimes above, sometimes below the middle: pod wider, 1½–3 in. long, ½in. wide; funicle short (not surrounding the seed), filiform and ending in fleshy aril. Fls. late Feb. and March. B.M. 3502.—This variety does not appear to seed in Calif.

23. **falcàta,** Willd. (*A. plagiophýlla,* Spreng.). Tree or tall shrub: phyll. distinctly pinniveined, lanceolate-falcate, much narrowed toward base, 3–6 in. long; nerve excentric; gland at base or none: racemes shorter than phyll., 20 fls. in a head; sepals free, narrow, ciliate, about half as long as petals; petals striate, with prominent midrib: pod flat, 2–3 in. long, ¼in. wide; seed longitudinal, close to the margin; funicle colored, extending around seed and bent back on itself in a double fold, enlarged at hilum end into a fleshy aril.—This may be distinguished from *A. penninervis* by its smaller pod (half the size), by its gland close to base instead of distant from it, and by its free, narrow, spatulate ciliate sepals.



72. Acacia leaves. 1, A. longifolia; 2, A. pravissima; 3, A. cyclops; 4, A. binervata; 5, A. implexa; 6, A. pycnanths; 7, A. saligna; 8, A. podalyriæfolia; 9, A. melanoxylon. (×½)

24. **penninérvis,** Sieb. MOUNTAIN HICKORY. A tall glabrous shrub or a tree, 40–80 ft. high: phyll. pinniveined, lanceolate-falcate, acuminate, much narrowed at the base, 3–4 in. long (sometimes twice that length) about ½in. broad; nerve excentric with a short secondary nerve terminating in a marginal gland below the middle: fls. pale yellow, in short racemes, much shorter than phyll.; peduncles ¼in. long: pod 3½–5 in. long, ½in. broad with nerve-like margins; seed longitudinal; funicle colored, extending around seed and bent back on same side so as to encircle in double fold. B.M. 2754. Maiden Wattles and Wattlebark, p. 35.—A variable species with very narrow phyll., often ¼–½in. wide and 8–12 in. long, the average being 1 in. broad and 5 in. long.

Var. **falcifórmis,** Benth. (*A. falcifórmis,* DC.). A shrub 6–10 ft. high with young shoots and infl. minutely hoary or golden pubescent: phyll. broad, obliquely ovate-oblong, obtuse, smooth and feather-veined, 3–4 in. long, 1 in. broad; gland at base: fls. in racemes.—Larger and more falcate than the type.

25. **pycnántha,** Benth. (*A. petiolàris,* Lehm.). GOLDEN WATTLE. BROAD-LEAVED WATTLE. Fig. 72. A small tree with more or less pendulous branchlets: phyll. pinniveined, oblong-lanceolate to falcate-lanceolate or even broadly obovate, 2½–6 in. long, ¾–1½ in. wide, 1-nerved, the nerve more or less excentric; gland ½–¾ in. from base: racemes either simple or compound, large-fld., fragrant and showy, often bending the tree with its weight of bloom; 50–60 fls. in a head with peduncles ½in. long; sepals 5, ciliate, almost as long as petals: pods varying, 2–4½ or 5 in. long, ¼in. wide, contracted and slightly constricted between the seeds and with nerve-like margins; funicle whitish, club-shaped, not folded, half as long as seed or occasionally folded and transverse to the seed; ripe Aug. Fls. Feb., March. Maiden Wattles and Wattlebark, p. 39. R.H. 1896, p. 504 Brown, For. Flora of S. Austral.—The name "broad-leaved" is derived from its reference to the seedling lvs., which are of great size, sometimes 5 in. long and 4 in. wide. The bark contains the highest percentage of tannin of any of the species, but the tree does not attain the size of *A. decurrens,* and hence so great a quantity is not obtained from any one tree. It is made into perfume, exudes a good gum, and is used as a sand-binder.

26. **salígna,** Wendl. (*A. leiophýlla,* Benth.). Fig. 72. A low tree or tall shrub with angular, rather drooping branches: phyll. lanceolate to linear-lanceolate, or even oblanceolate, 3–8½ in. or lower lvs. 1 ft. long, ¼–1¼ or even 1¾ in. wide, acute to obtuse, narrowed to base; 1 central nerve, often excentric, ending in a recurved point or obtuse; gland at base or none: fls. large (½in. in diam.), either in large racemes at the ends of the branches or reduced to 4 or 5 heads strung along the axils of the lvs. for 2 or 3 ft.; peduncles varying from ¼–½in. in length: pods constricted between the seeds, flat with nerve-like margins, 3–5 in. long, ¼in. wide; funicle club-shaped, three-fourths length of seed; ripe Aug. Fls. March–May and to slight extent at various times.—Botanists do not find any well-marked differences between this species and the next and are therefore inclined to combine the two. Nurserymen base their distinction on the color of the phyll., a bluish-tinged one being called *A. cyanophylla,* while the green phyll., especially if it is smaller, is called *A. saligna.* Both forms are also said to have been secured from seed gathered from a single tree. Nurserymen should test this to satisfy themselves. Another so-called botanical distinction gives the funicle straight in one species and folded in the other. This does not hold, as such a combination can be seen in the same plant, and even in the same pod. This species is variable in other respects. Fls. may be in groups of 4 or 5 and strung along the axis of lvs. for 2 or 3 ft. This type may have either large or small or even mixed phyll., or the fls. may be in large clusters (either erect or pendulous) at the ends of the branches. In either case, the large or the small or the mixed types of phyll. may accompany them.

27. **cyanophýlla,** Lindl. BLUE-LEAVED WATTLE. Tall shrub, 18 ft., stoloniferous: branches drooping: lower phyll. about 12 in. long; upper 6 in. or less and narrower, linear-oblong to lanceolate-falcate, much narrowed toward the base, glabrous and often glaucous: peduncles ¼–½in. long; fls. 3–5, large, golden yellow. March. Gn. 52, p. 99.—Said to be the same as *A. saligna,* as they run into each other.

28. **obtusàta,** Sieb. Tall, glabrous shrub: phyll. 1½–3 in. long, oblong-linear, or almost spatulate, usually almost straight, rather obtuse, point not curved, thick, rigid, with thickened, nerve-like margins; marginal gland 1, distant from the base, not prominent: racemes about ¾in. long, with densely packed heads; fls. 30 or more. March.

29. **retinòdes,** Schlecht. A tall shrub or small tree: phyll. lanceolate, with nerve-like margins and narrowed to base, acute, pinnately veined, 3–6 in. long, ¼–¾in. wide; gland ¼in. from base: fls. in racemes, mostly compound; peduncles ¼in. long; 30–40 fls. in a head: pod flat, with nerve-like margin, 3–4 in. long, about ¼in. wide; funicle colored red, encircling seed, bent back upon itself in a double fold and ending in club-shaped aril; ripe June–Oct. Fls. Feb.–Sept. F. v. M. Icon. 5:9.—Very closely resembling *A. neriifolia* in foliage and fls., but differs in pod, being narrower than that of *A. neriifolia*, while the funicle is red and encircles seed in double fold.

30. **neriifòlia,** Cunn. A small tree with angular branchlets: phyll. lanceolate, acute, narrowed at both ends, 1½–5¼ in. long, ¼–⅜in. wide, 1 central nerve; gland ½in. from base: fls. about 40 in a head, 5-merous, in short racemes; sepals 5, separate, ciliate; peduncles ⅛–¼in. long: pods with nerve-like margins, contracted between the seeds and often constricted, a rich brown, 3–6 in. long, ⅝in. wide; funicle white, short, not encircling seed, but thickened into a club-shaped aril; seed longitudinal, oval, with central depression. Fls. July.

31. **suavèolens,** Willd. A glabrous shrub, 3–6 ft. tall: phyll. linear to lanceolate, apex acute, tapering to base; 1 central nerve; gland near base: fl.-heads in axillary racemes, at first inclosed by imbricate scaly bracts, which soon fall; fls. 6–10 in a head: pod oblong, rounded at both ends, flat, impressed between the seeds, 1–1½ in. long, ½–⅔in. wide; seeds transverse; funicle filiform and suddenly enlarged into fleshy aril at right angles to itself. Fls. Apr.—Superficially it resembles narrow-lvd. *A. retinodes*, but note the imbricated bracts; the pods are shorter and wider and the funicle does not encircle the seed.

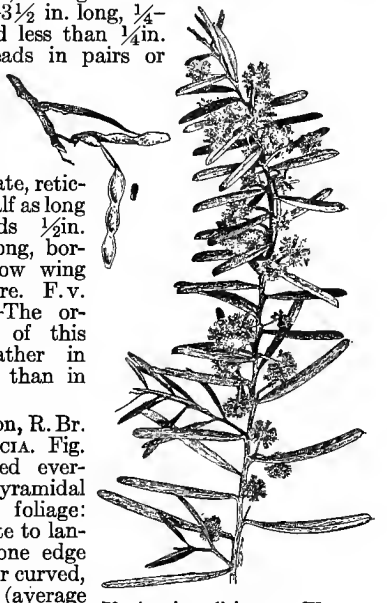
32. **macradènia,** Benth. A glabrous shrub, 10–12 ft. tall, or, in favorable situations, a tree 30–50 ft. high: phyll. lanceolate-falcate, narrowed to base, 5½–12 in. long, ½in. wide; veins fine, prominent and transverse; gland at base, large or often wanting: racemes compound, short; fls. small; petals pubescent; calyx more than half as long as corolla, turbinate, toothed and ciliate: pod with nerve-like margin, 2–4 in. long, ¼in. wide or more, slightly constricted between the seeds; seeds longitudinal; funicle not enfolding seed but bent upon itself and ending in club-shaped aril, about half as long as seed. F. v. M. Icon 5:7.—A beautiful close-grained wood that is capable of taking a high polish.

33. **salícina,** Lindl. Small tree; branches drooping: foliage pale; phyll. 2–5 in. long, ¼–½in. wide, oblong-linear or lanceolate, narrowed at base, thick, rigid, with a curved point; midrib and marginal veins scarcely prominent: racemes short, often reduced to 2 or 3 heads, or even only 1; peduncles slender; fls. about 20 in the head: pods straight, 1–3 in. long, ¼in. broad, valves convex, hard and thick; seeds longitudinal; funicle thickened and usually scarlet almost from the base, forming several folds under the seed.—The timber is dark brown and tough, taking a high polish. It is a good forage plant and on this account is becoming scarce in the wild state.

Var. **Wàyæ,** Maiden. Fig. 73. A shrub 8 ft. tall, which blooms sparingly at various times during the year: phyll. somewhat thick (flat when dried) and succulent-looking, oblong-linear, narrowed at base, 1½–2½ in. long, less than ¼in. wide; 1 central nerve ending in oblique point; gland below middle: fls. solitary or in pairs, or occasionally in short racemes of 3–5 fls.; sepals united, truncate; petals 5: pod 1–2 in. long, less than ¼in. broad, contracted between the seeds; seed longitudinal; funicle scarlet its entire length, folded several times at one end of seed; ripe June–Sept. Fls. Feb.–May.—A neat little shrub with bright green lvs. The pods must be picked as soon as ripe and just before dehiscence, for the elastic opening of the pod will discharge the seed in every direction.

34. **binervàta,** DC. (*A. umbròsa*, Cunn.). Fig. 72. Two-veined Hickory. A tall shrub or shrubby tree of 25 ft., with terete branchlets: phyll. falcate-lanceolate to triangular, with 2 distinct veins (occasionally 3-veined) and pinnately veined between, 2½–4 in. long, ⅛–1 in. wide; gland ½in. from base: fls. in racemes shorter than phyll.; peduncles ¼in. long or more, 30 fls. in a head, 4- or 5-merous; calyx not half so long as corolla: pods straight, very thin, convex over seed, 4–5 in. long, ½in. wide; seed oblong; funicle long, nearly encircling seed and bent back upon itself in double dark red fold, with light aril at hilum end. B.M. 3338. Maiden, Flowering Plants of New S. Wales, pt. 5, p. 53. Wattles and Wattlebarks, p. 50.—It inhabits dry, shaded woods in the mountainous district of the coast.

35. **péndula,** Cunn. Weeping Myall. A small tree with gray foliage and pendulous branchlets: phyll. covered with a minute pubescence, finely striate with 3–5 obscurely parallel veins, linear-lanceolate, often falcate, acuminate, ending in mucronate point, 2–3½ in. long, ¼–⅓in. wide; gland less than ¼in. from base: fl.-heads in pairs or clusters, about 30 in a head; peduncles less than ½in. long; petals with midrib; sepals spatulate, reticulately veined, half as long as petals: pods ½in. broad, 2–3 in. long, bordered by a narrow wing along each suture. F.v. M. Icon. 6:8.—The ornamental value of this species lies rather in drooping foliage than in the fls.



73. Acacia salicina var. Wayæ. (×½)

36. **melanóxylon,** R. Br. Blackwood Acacia. Fig. 72. A good-sized evergreen tree of pyramidal form and dense foliage: phyll. oblanceolate to lanceolate, usually one edge straight, the other curved, 2½–4½ in. long (average 3½ in. long by ¾in. wide), 3–6 parallel nerves, reticulately veined between; gland ⅛in. from base: fls. cream-color, 40–50 in a head, with peduncles over ½in. long, and in short racemes of 3–5 heads: pod reddish brown, with nerve-like margins, more or less twisted into shape of letter C or S, 3–5 in. long, ⅜in. wide; seed longitudinal, ⅛in. in length, encircled in double fold by a long red funicle which is very characteristic of the species, the seed hanging on the trees thus for months; pods ripe July–Nov. Fls. late Feb. and March. B.M. 1659.—Its wood is but little inferior to black walnut for furniture-making and grillwork; it makes a good street tree in Calif. and as a fuel it is equal to hickory.

37. **implexa,** Benth. Fig. 72. A tall tree, 50 ft. high, with light green foliage and rough bark: phyll. falcate-lanceolate, acuminate, with a more or less hooked point, 4–7 in. long, ⅜–¾in. wide, veins 3–5, with finer parallel veins between; no gland: fls. cream-yellow, in racemes much shorter than phyll., 40–50 in a head; peduncles ⅜in. long: pod curved, often like an interrogation point, light brown with nerve-like margin, more or less constricted and contracted between the seeds, 4–6 in. long, ¼in. wide; seeds longitudinal; funicle

club-shaped, folded once or twice at end of seed. F. v. M. Icon. 8:2.—Distinguished from *A. melanoxylon* by the more pointed and hooked phyll., while the funicle is cream-colored and folded at the end of the seed instead of being scarlet and twice encircling it as in *A. melanoxylon*.

38. **kôa,** Gray. KOA. Tree of 50–60 ft., with spreading branches: phyll. falcate, acuminate and tapering to base, striate with 3–5 parallel nerves more prominent, 4–5 in. long, ⅜–½in. wide; gland at base prominent: fls. in short racemes or rarely solitary, or in pairs, 50–60 fls. in a head; peduncles ½in. long, 5-merous; calyx united, ciliate edges: pod brown, flat, thin, reticulately nerved, more or less constricted between seeds, 5–6 in. long, ¾–1 in. wide; seed dark brown, nearly transverse, oblong, about ½in. long by ¼in. wide; funicle light brown, filiform, not encircling seed but with 2 or 3 twists at hilum end. Hawaiian Isls.—A valuable timber tree, capable of receiving a high polish. It should be more largely grown in Calif.

39. **viscídula,** Cunn. A tall shrub, 12–15 ft. high, with terete branches covered by a glossy viscid gum: phyll. long-linear, with a small oblique point, sparingly pubescent, at least when young, 2–3½ in. long, $\frac{1}{12}$ to less than ¼in. wide, with several obscure parallel veins; gland near base: fls. 40 in a head, solitary or in pairs, either 5- or 4-merous, with peduncles ¼in. long; calyx and corolla pubescent: pod hirsute, with nerve-like margins, 1¼–2 in. long, ⅛in. wide, slightly depressed between the seeds; seed small, longitudinal; funicle silvery, twice or thrice twisted and thickened into cap at end of seed; ripe Aug. Fls. March, Apr.—At first glance easily mistaken for narrow-lvd. *A. retinodes*, but its short-std. fls. in pairs, the resinous viscid substance on phyll. and its small narrow pods will at once distinguish it.

74. Acacia verticillata. (×½)

40. **elongàta,** Sieb. A tall shrub with angular branchlets: phyll. distinctly striate, 3-nerved, or often obscured, long-linear, slightly falcate, narrowed to base, obtuse and ending in oblique point, 2–3½ or 4 in. long (or narrower and 5½ in. long), hardly ⅛in. broad; peduncles ½in. long, solitary or in pairs: pod thin, with nerve-like margins, 1½–2½ in. long, ⅛in. wide, slightly impressed between seeds, pod convex over them; seed oblong, brown; funicle not folded about seed but with 2 or 3 folds fitting over end of seed like a cap. B.M. 3337.—Especially suitable for damp, sandy land.

41. **Óswaldii,** F. v. M. A stiff shrub, 8 to 10 ft. tall: phyll. linear to oblong-falcate, with numerous fine parallel veins ending in oblique mucronate point, 1–2 in. long, nearly ¼in. wide; gland near base: fl.-heads sessile, solitary or in pairs, about 15–20 in a head; sepals over half as long as petals: pods hard, curved into crescents about each seed; funicle filiform, half the length of seed and suddenly dilated into a cap nearly as long, which fits over and covers up one-third of seed. F. v. M. Icon. 6:10.—May be easily recognized by its finely striate, narrow, 2-in.-long phyll., its sessile yellow fls. that sit at base of phyll., nearly hiding st., by the pods twisted in lunar shape with valves convex over seed and by the cap covering one-third of seed. A small bushy tree in Australia, producing a scented timber; the natives make short weapons from it.

42. **harpophýlla,** F. v. M. A tree with slightly angular branchlets: phyll. striate, 3–5-nerved, falcate-lanceolate, tapering to both ends, 6–8 in. long, ⅛–¾in. wide: fls. in clusters with peduncles ½in. long, or in short racemes, much shorter than phyll., 15–20 fls. in a head; sepals not half so long as petals: pod striate, more or less constricted and contracted between seeds, 3–4, or even 5, in. long, ⅛in. wide; seed elliptic; funicle half as long as seed and but slightly enlarged into aril. F. v. M. 6:9.

43. **cỳclops,** Cunn. Fig. 72. A low spreading shrub, 8–10 ft. tall, with many sts.: phyll. narrow-oblong to lanceolate or even falcate-lanceolate, with oblique point, 1½–3½ in. long, ¼–⅜in. wide, gland at base more or less obscure; 3–6 longitudinal nerves: fls. solitary or in pairs, or even in short racemes; peduncles ¼in. long: pods in clusters of 2–7 from one head, 2–2½ in. long, ⅜in. wide, more or less curled; seeds transverse, with odor, when fresh, something like a leek, surrounded by conspicuous scarlet funicle in double fold; ripe Aug.–Nov. Fls. off and on from July–Dec. F. v. M. Icon. 8:3.—Young specimens are very compact and attractive, although in a few years they become spreading and unsymmetrical; but, as short-lived tub-plants for certain formal effects, they would be very effective. While the seed-pods are at first charmingly artistic with the scarlet funicle surrounding the black seeds and the rich brown pods, in age they are unsightly, as they persist until they are ragged, ugly and black. The pods contain much tannin that is hard on the mucous membrane when the seeds are cleaned.

44. **oxycèdrus,** Sieb. A rigid shrub with terete and usually pubescent branches: phyll. striate, linear-lanceolate but broad at base and tapering to a pungent point, ½–¾in. or even 1 in. long and 3–4-nerved on each side; small stipules, often spinescent: spikes 1 in. long; fls. 4-merous; calyx short with obtuse lobes: pods 3 in. long, ⅛in. wide, striate, incurved and with convex valves; seed longitudinal; funicle thickened from the base and much folded. B.M. 2928.—Superficially resembles *A. verticillata*, but the phyll. are broader and the valves of the pods are thicker than in that species.

45. **verticillàta,** Willd. (*Mimòsa verticillàta*, L'Her.). WHORL-LEAVED ACACIA. Fig. 74. A spreading shrub or small tree of graceful habit; branches more or less pubescent: phyll. in whorls or often scattered, linear-subulate, about ½–⅝in. long, or more, less than ⅛in. wide, ending in a pungent point; 1-nerved; occasional gland near middle: spikes ½–1 in. long, often concealing the phyll.: pods flat, straight or slightly curved, with nerve-like margins, 2–3 in. long, ⅛in. wide, tapering to a point; seeds longitudinal, ¼in. long, with light-colored funicles of about same length thickened at end of seed into cup-shaped aril; ripe June and early July. Fls. March, Apr. B.M. 110.—Used for hedges and as ornamental; also to some extent as a street tree, in which case it may be trimmed to assume a pyramidal form, but can hardly be recommended for this purpose since it is short-lived and in age becomes straggling. It may be made to assume a pendulous habit by weighting its branches with a brick when young. There seem to be several types, some being soft to the touch while others are harsh and rigid. There is also much difference in the length of the fl.-spikes.

46. **Riceàna,** Hensl. (*A. erýthropus*, Tenore). A tall shrub or small tree, with graceful drooping branchlets: phyll. clustered, less than 1 in. long and $\frac{1}{12}$in. broad (or narrower and 1½ in. long) linear-subulate, tapering into pungent point: spikes slender, 1½–2 in. long;

peduncles ½in. long; fls. distant, acute in the bud, 3-merous, the petals with distinct nerve; calyx short, ciliate: pod usually curved, acuminate, often 2–3 in. long, scarcely ⅛in. broad, slightly pubescent when young, but soon glabrous; valves very convex, coriaceous, contracted between the seeds; seeds longitudinal; funicle much folded and thickened nearly from the base. Fls. lemon-yellow, last of Feb. and March to Apr. Tasmania. N 1:7. This may be distinguished from *A. verticillata* by its phyll. in clusters rather than in whorls and by its distant, 3-merous fls. Its habitat is in moist shady places in its native country.

47. **aneùra,** F. v. M. MULGA. A shrub with terete branches lined with gum along the longitudinal fissures: phyll. rigid, with oblique point, varying from lanceolate-falcate to long-linear or almost terete on the same plant, 1–3 in. long, $\frac{1}{24}$in. wide; no prominent nerves, but distinctly striate under a lens: fls. in spikes (which may be single or in pairs), ½–¾in. long, 5-merous; calyx narrow spatulate, not half so long as petals; peduncles less than ¼in. long: pods flat, oblique, with a narrow wing at suture and recurved point at apex, 1–1½ in. long, nearly ½in. wide; seeds nearly transverse, marked by a minute horseshoe; funicle not encircling seed but with 2 or 3 short thick folds. F.v.M. Icon. 10:8.

48. **glaucéscens,** Willd. (*A. cineráscens,* Sieb. *A. homomálla,* Wendl. *A. leucadéndron,* Cunn.). A tree up to 50 ft. high, with branchlets and phyll. covered with a gray pubescence which gives an ashy hue to the foliage, the young shoots yellowish: phyll. lanceolate to sickle-shaped, widest in center and tapering at both ends, striate, with 3 or 4 nerves more prominent, 3½–6 in. long, from less than ½–¾in. or even 1 in. wide; gland near base: spikes several, in the axils of the phyll., 1–2 in. long; fls. 4- or 5-merous; petals united and very narrow at base giving prominence to the short united sepals covered with a bright yellow pubescence like pile on velvet. According to J. H. Maiden, the pod, as originally described, was that of *A. Maidenii,* and the error seems to have been copied into subsequent publications. B.M. 3174.—This is often confused with *A. Maidenii,* but that species is less pubescent, has a much-twisted pod, and red funicles almost encircling seeds. It is known as the Coast Myall.

49. **Maìdenii,** F. v. M. A tall shrub or tree 50 ft. high, with rough bark, fissured at intervals: phyll. lanceolate to lanceolate-falcate, narrowed at each end, striate with fine veins, several more prominent, more or less pubescent, 4–6 in. long, ⅛–½in. wide; gland about ¼in. from base: fl.-spikes in pairs about 1 in. long; fls. 4-merous, calyx not half so long as corolla: pod narrow, ⅛in. wide, variously twisted into bow-knots and usually with one suture of the valves gaping open; seeds longitudinal, shining, black, funicle pale reddish, almost or quite encircling the seed and suddenly doubled back from the summit. Fls. Sept.

50. **holoserícea,** Cunn. (*A. leucophýlla,* Lindl. *A. neurocárpa,* Cunn.). A shrub or small tree 10 to 20 ft. high, clothed with a white, silky pubescence; branchlets with 3 much-raised angles: phyll. obliquely oval-oblong, obtuse or mucronate, 4–6 in. long, 1–3 in. wide, 3–4 nerves, pinnately veined between them: fls. 5-merous in spikes 2 in. long; calyx and corolla pubescent: pod more or less twisted; seeds longitudinal; funicle folded and enlarged into cup-shaped aril. Fls. March.

51. **lineàris,** Sims (*A. longíssima,* Wendl.). A straggly shrub with phyll. as long and slender as pine needles, 4–8 in. long, or twice that length, $\frac{1}{12}$in. wide; prominent longitudinal vein: fls. loose, slender in interrupted spikes, 1–2 in. long, 4-merous; calyx short, not half so long as corolla: pod 4 in. long, ⅛in. broad, slightly impressed between seeds and convex over them; seeds longitudinal, oblong, shining; funicle not surrounding seed but bent back and forth into a cap-shaped aril over one end. B.M. 2156. B.R. 680.—It may grow to 20 ft. in height, and the wood is useful for furniture and many small articles.

52. **longifòlia,** Willd. SYDNEY GOLDEN WATTLE. Fig. 72. A tall shrub or small tree: phyll. oblong-lanceolate, either acute or obtuse, narrowed to the base, 2–3 in. or even 4–6 in. long and from ¼–½in. wide; 3 or 4 longitudinal nerves, reticulately veined between; gland very near base: fls. in spikes ¾–2¼ in. long, 4-merous: pods 1½–3¾ in. long or more, about ¼ in. broad, coriaceous, terete until fully ripe when their valves flatten, separate, become dark and curled and persist on the tree; seeds longitudinal, black, fat and shining; funicle silvery, not enfolding seed but bent upon itself several times, dilated and fitted like a cap over one end of the seed; ripe Aug, Sept. Fls. Feb., March. B.R. 362. B.M. 2166. R.H. 1896, p. 504. Wattles and Wattle-barks, p. 51.—A valuable ornamental as well as a good tree for narrow streets; also used as a tan for heavy leathers.

Var. **Sophòræ,** F. v. M. (*A. Sophòræ,* R. Br.). Phyll. shorter, and with rounded apex, 1½–3½ in. long, ¾–$\frac{1}{12}$in. broad: spikes generally shorter, 1–1½ in.; blooms later and seed matures later than type. Brown, Fl. of S. Austral.—Under cult. it becomes difficult to distinguish this from the type, but in general its foliage is shorter and more rounded at apex.

Var. **floribúnda,** F. v. M. A tall shrub or small tree, with the foliage all at the ends of the branches, giving the tree a thin, delicate appearance: phyll. 2½–3¼ in. long, ⅛–¼in. wide, or more, linear-lanceolate, ending in oblique point, acuminate, striate, several nerves more prominent than others: spikes 1½ in. long, flowering to base; fls. whitish yellow: pods contracted and long-constricted between seeds; seed longitudinal; funicle silvery, not encircling seed but folded like a cap; ripe July, Aug. Fls. Feb., March. B.M. 3203 (as *A. intermedia*).—This varies so much from the type that it is difficult to conceive of its relationship, but since all variations between this and the type can be traced, it can be given only varietal rank.

53. **pubéscens,** R. Br. HAIRY WATTLE. A shrub, with drooping branches and hirsute petioles and rachis; pinnæ 3–10 pairs (mostly 3–8), ½–¾in. long; lfts. 6–20 pairs (mostly 16), crowded, linear, smooth, $\frac{1}{12}$–⅙in. wide: fls. in simple racemes longer than lvs., on long pubescent peduncles, 15–20 in a head; calyx short, sinuate-toothed; corolla smooth, protruding in bud, the petals united. Blooms in spring. B.M. 1263. F.R. 1:733.—This belongs to the series in which the pods are all flat, seeds longitudinal, last fold of funicle forming a short lateral or oblique aril, with very small folds below it. Much grown in greenhouses in the E. U. S., where it is a general favorite on account of its feathery lvs. and bright blossoms, which are in their full beauty at Eastertide, and are becoming very popular for church decorations at that time.

54. **elàta,** Cunn. A handsome tree of 50–60 ft. with dark green foliage and young shoots clothed with a yellow pubescence: lvs. compound, 1 ft. long by 8–10 in. wide; pinnæ 2–6 pairs, 5–7 in. long; lfts. 8–13 pairs, lanceolate, acuminate, pubescent, 1¼–1½ in. long, ¼–⅜in. wide, about ⅜in. distant: fls. in compound racemes, about 40 in a head; sepals 5, united, half as long as petals; petals 5: pod a rich brown, with nerve-like margins, 3½–6 in. long, ⅜in. broad; funicle silvery, the club-shaped aril half as long as lenticular seed; ripe Aug. Blooms Sept., Oct., Dec. etc. F. v. M. Icon. 12:7. Wattles and Wattle-barks, p. 54.—Rich in tannic acid. Grows in shaded ravines in its native country.

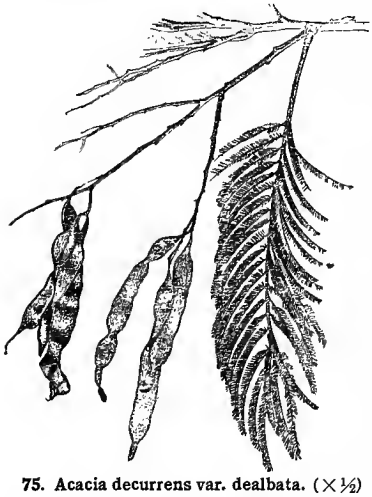
55. **Baileyàna,** F. v. M. An attractive shrub or small tree, with gray foliage arranged spirally around the branchlets and nearly concealing them: lvs. com-

pound, 1–2 in. long, with gland at base of each pair of pinnæ; pinnæ 2–3 pairs (occasionally 4), 1 in. long; lfts. about 20 pairs, ¼in. long, nearly $\frac{1}{16}$in. wide: racemes longer than lvs., 2–3½ in. long; fls. 15 in a head, on peduncles ⅛–¼in. long: pod 1½–4 in. long, ½in. wide, with nerve-like margins, occasionally constricted between seeds; seeds transverse, ¼in. long, with club-shaped funicle one-half its length; ripe July, Aug. Fls. Jan., Feb. F. v. M. Icon. 12:5. G.C. III. 15:37.—A much-prized ornamental and sometimes used as a street tree.

56. **díscolor,** Willd. A tall shrub or small tree, either glabrous or pubescent: pinnæ 2–6 pairs; lfts. 10–15 pairs, ¼–⅓in. long, 1-nerved, pale beneath; large gland on petiole and a few small ones on upper pairs of lfts.: fls. 6–15 in a head, in axillary racemes, 5-merous; petals with prominent midribs; calyx short, ciliate: pod flat, with nerve-like margins, 1–3 in. long, ⅜in. wide; funicle enlarged at hilum end.

57. **pruinòsa,** Cunn. A small tree with young foliage bronze-like: pinnæ 2–4 pairs, 2½–4 in. long; lfts. 11–24 pairs, ½–¾in. long, oblong to linear; nerve excentric, occasionally 1 or 2 short nerves; gland prominent, distant from base: fls. in racemes, 30 in a head, 5-merous; sepals united, half the length of petals: pods with nerve-like margins, 2½–3 in. long, ⅜in. broad, occasionally constricted between seeds; funicle short, filiform half its length, then enlarged into club-shaped aril. Fls. Feb.–Apr.

58. **decúrrens,** Willd. GREEN WATTLE. A handsome tree, glabrous or more or less tomentose-pubescent with branches more or less prominently angled: pinnæ 8–15 pairs or more (sometimes reduced to 5 or 6); lfts. 30–40 pairs or more, linear, from under 2 to nearly 5 lines long, according to the variety: fls. 20–30 in a head, mostly 5-merous: pods 3–4 in. long, about ¼in. broad, more or less contracted between the seeds. Wattles and Wattle-barks, p. 55. Brown, For. Fl. of S. Austral.—There is much confusion regarding this group among nurserymen and others.



75. Acacia decurrens var. dealbata. (×½)

Var. **normàlis,** Benth. SYDNEY BLACK WATTLE. Lfts. ¼–⅓in. long. Restricted range on the coast of Austral. According to Maiden, var. *normalis* differs from type in having sepals as long as petals and cilia on interior of lobe: in *A. decurrens,* the petals have a midrib and a short, broadly lobed ciliate calyx.

Var. **móllis,** Lindl. (*A. mollissima,* Willd.). BLACK WATTLE. A tree 20–50 ft. high, with reddish bark showing under the fissures: pinnæ 8–20 pairs, shining on upper surface, 2–6 in. long; lfts. 30–60 pairs, closely crowded, not ⅛in. in length; gland between each pair of pinnæ and generally additional ones on internodes between: fl.-clusters in racemes, 30–36 in a head, 5-merous; peduncles ⅛–¼in. long: pods dark, pubescent, 2–4 in. long, not ¼in. wide, constricted and contracted between the seeds; seed longitudinal; funicle filiform, enlarged to a light-colored cap over seed; ripe June–Oct. Fls. pale yellow, blooming profusely in June and intermittently at other times. B.R. 371.—Distinguished from var. *dealbata* by its later blooming period, by its lighter fls., its characteristic pubescent pods and smaller seeds and by the short lfts., shining above, which sit close together.

Var. **dealbàta,** F. v. M. (*A. dealbàta,* Link). SILVER WATTLE. Fig. 75. A tree 50 or more ft. high, with smooth bark and gray pubescent branchlets: lvs. silver-gray to light green, 3–6½ in. long; pinnæ 13–25 pairs; lfts. 30–40 pairs; glands 1 between each pair of pinnæ: racemes often compound, 30 fls. in a head, 5-merous; sepals united; petals with faint midrib; peduncles ¼in. long: pods 1½–4¼ in. long, ⅜–½in. wide, smooth, a rich brown; seeds longitudinal; funicle as long as seed, filiform half its distance and ending in silvery club-shaped aril; ripe July, Aug. Fls. Feb., March. A.F. 13:880. R.H. 1896 p. 502.—Mts. in its native country. It is sometimes given specific rank as *A. dealbata,* but intermediate forms occur.

59. **filicìna,** Willd. (*Mimòsa filicioìdes,* Cav.). TIMBE. Unarmed shrub: lvs. fern-like; pinnæ 5–30 pairs; lfts. 20–50 or more pairs (rarely 10–15), very small: fl.-heads globular, orange or yellow, in terminal panicles: pods broadly linear, straight or slightly curved, often irregular, flat not pulpy. Texas and Mex.—The astringent, bitter bark called *timbe* is used by the Mexicans in making pulque for precipitating mucilaginous matter. Safford, Science, Jan. 22, 1909: 160.

60. **pulchélla,** R. Br. A handsome shrub, either glabrous or hirsute, with slender branches, mostly armed with subulate spines: pinnæ 1 pair; lfts. 4–7 pairs, obovate-oblong, $\frac{1}{12}$–¼in. long; gland on stipes between pinnæ, or none: peduncles solitary; fls. 5-merous; petals with prominent midrib; calyx half as long as petals and sinuate-toothed: pods flat, thick margins, 1–2 in. long, ⅛–¼in. wide; seed longitudinal; funicle filiform and thickened into club-shaped aril. Fls. Apr.

Var. **grândis,** Hort. (*A. grándis,* Henfr.). Glabrous: lfts. 8–10 pairs, a little larger and more numerous than the type. Fls. Feb.–May. J.H. III. 35: 369 (1897).

Var. **hispidíssima,** Hort. (*A. hispidíssima,* DC.). Branches covered with long, spreading hairs: lfts. narrow and revolute: fls. white. B.M. 4588.

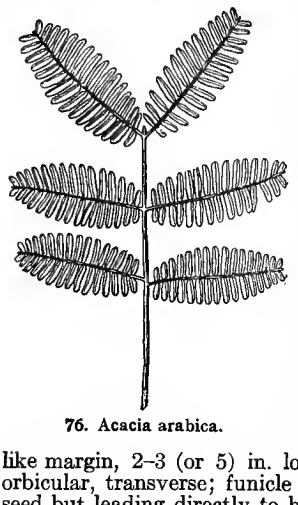
61. **Farnesiàna,** Willd. (*A. leptophýlla,* DC.). POPINAC. OPOPANAX. CASSIE. HUISACHE. Much-branching shrub, 6–10 ft.: stipules straight, slender, sometimes minute spines; pinnæ 5–8 pairs; lfts. mostly 10–25 pairs, 1–2 lines long, narrow, linear, glabrous: peduncles 2 or 3 in the older axils; fl.-heads large, globular, deep yellow, very fragrant: pods almost terete, indehiscent, at length turgid and pulpy. Feb., March. Texas, Mex., Asia, Afr. and Austral. Grown in France for perfumery.—Its origin is probably American, but it is now naturalized in nearly every tropical country. It was intro. into the Hawaiian Isls. as an ornamental, but escaped from cult. and has now almost become a pest. A new variety of *A. Farnesiana* has been discovered which is more hardy than the type and grows more rapidly. It produces two crops of fls. a year, which makes it very lucrative for the making of perfumery. The pods are said to contain a tannin.

62. **Cavènia,** Bert. ESPINO CAVAN. Height 20 ft.: spines stout: lfts. scabrous, scabrous-pubescent. Otherwise near to *A. Farnesiana,* of which it is sometimes considered a mere variety. Chile.—A good hedge plant.

63. **arábica,** Willd. GUM ARABIC TREE. Fig. 76. Shrub or small tree with gray branchlets; stipules spiny: pinnæ 3–8 pairs, ½–1½ in. long; lfts. 10–20 pairs, ⅛–¼in. long, glands several: fls. in groups of 2–5, calyx half the length of corolla: pods distinctly stalked, flat, mostly moniliform, gray-downy, 3–6 in. long. Arabia and Eu.—Some confusion exists between this species and *A. Farnesiana,* but they are easily distinguished by means of the pod which in *A. arabica* is

from slightly constricted between the seeds to moniliform or bead-like, while in *A. Farnesiana* it is round and smooth with the seeds arranged in 2 rows in a pulpy mass.

64. **ebúrnea,** Willd. A shrub with a reddish brown bark: lvs. 1–1¼ in. long.; phyll. 5 or 6 pairs, ¼–⅜in. long; lfts. 5–9 pairs, less than 1½ in. long; stipules ¼–2 in. long; gland between each of the 2 lowest pairs: fls. 40 in a head on peduncles ½–1 in. long with a circle of bracts at middle; petals 5; sepals united, half as long as petals: pod flat, 3–6 in. long, ⅜in. wide; seeds longitudinal; funicle short.—A desert region species and also used as a forage plant.



76. Acacia arabica.

65. **Cátechu,** Willd. (*A. catechuòides*, Benth.). A medium-sized tree, with opposite, recurved, stipular spines: pinnæ 10–40 pairs; lfts. 30–50 pairs, linear, about ¼in. long; gland near base and between upper pair of pinnæ: spikes solitary or fascicled, 2–5 in. long; calyx and corolla tomentose, the former half the size of the latter: pods dehiscent, flat; a rich brown, reticulately veined and with nerve-like margin, 2–3 (or 5) in. long, ½–¾in. broad; seed orbicular, transverse; funicle flat, not curving around seed but leading directly to hilum with a twist or two. E. Indies.

66. **Drúmmondii,** Benth. Bush or small tree: pinnæ 2–4 pairs, each with 4–10 linear, very obtuse, glabrous lfts.: fls. pale lemon-yellow, in dense, solitary, drooping spikes 1–1½ in. long: pod not exceeding 1 in. long, ¼in. broad, flat, with thickened margins, glabrous or pubescent; seeds transverse; funicle short, thickened into small aril of about 2 folds under seed. B.M. 5191.—A favorite greenhouse species.

67. **Gréggii,** Gray. TEXAS MIMOSA. Sometimes a tree 20 ft. high, but usually a shrub of 4–5 ft., growing in thickets along river banks: compound lvs. 1 in. long, pubescent; pinnæ 2–3 pairs (occasionally reduced to 1 pair), ½–¾in. long; lfts. 4–7 pairs (usually 5), oblong, pubescent and 2-nerved: spikes cream-yellow, 1¼–2¼ in. long, including the peduncles, which are half the length of spikes; petals and sepals greenish, 5-merous; sepals united and half as long as petals: pods much bent and twisted, nerve-like margins and more or less constricted between the seeds, 1½–4 or more in. long, about ¾in. wide; seed ⅛in. long, ¼in. wide with an arrow-shaped depression in the center; funicle filiform its entire length. Fls. Aug., Sept. In dry or rocky places in Texas and N. Mex. and S. Known as Devil's Claws and Catsclaw from the short curved, spines; also as Paradise Flower.

In the following supplementary list, the heights given are those attained by the plants under glass in N. Eu.; in the open air in the S. W. U. S. they often grow much taller, and sometimes flower 2 months earlier. Except when otherwise stated, the fls. are yellow. Those marked (*) are considered most desirable. Those marked "stove" need hothouse treatment; the others can be grown in a coolhouse, or in the open in Calif. *A. abietìna*, Willd.=A. linifolia.—*A. acanthocárpa*, Willd.=Mimosa acanthocarpa.—*A. acapulcénsis*, Kunth.=Lysiloma acapulcensis.—*A. accòla*, Maiden & Betche.—*A. aciculàris* (Needle-leaved Acacia). 4 ft.—*A. affínis*, Sweet=A. dealbata.—*A. alàta*, R. Br. 6 ft. May. B.R. 396.—*A. álbicans*=Pithecolobium albicans.—*A. amœna*, Wendl. 3 ft. May. Near to A. heterophylla.—*A. angulàta*, Desv.=A. discolor.—*A. angustifólia*, Lodd.=A. longifolia var. floribunda.—*A. argyrophýlla*, Hook.=A. brachybotrya var. argyrophylla.—*A. áspera*, Lindl. (A. Ausfeldii, Regel. A. densifolia, Benth.). 4 ft. May.—*A. Ausféldii*, Regel=A. aspera.—*A. Bancroftiàna*, Bert.=Cæsalpinia bijuga.—*A. Bartheriàna*, Hort.=A. Berteriana(?).—*A. Berlandièri*, Benth. Fls.(?). Mex.—*A. Berteriàna*, Balb.=Pithecolobium fragrans.—*A. biflòra*, R. Br. 3 ft. May.—*A. brachyacántha*, Humb. & Bonpl.=Mimosa acanthocarpa.—*A. brevifólia*, Lodd.=A. lunata.—*A. brévipes*, Cunn.=A. melanoxylon.—*A. Burmanniàna*, DC. Shrub 6 ft. Ceylon. Stove.—*A. buxifólia*, Cunn. 4 ft. Apr. Hook. Icon. 164.—*A. cæsia*, Wight & Arn. (A. Intsia, Willd.). Climber beset with curved prickles. E. Indies. Stove.—*A. calamistràta*, Hort. lists=(?).—*A. celastrifólia*, Benth.=A. myrtifolia var. celastrifolia.—*A. centrophýlla*, DC. 20 ft.: white. Jamaica. Stove.—*A. Ceratònia*, Willd.=Mimosa Ceratonia.—*A. chrysóstachys*, Hort.=Piptadenia chrysostachys.—*A. ciliàta*, R. Br.=A. strigosa.—*A. cineráscens*, Sieb.=A. glaucescens.—*A. cochleàris*, Wendl. 4 ft. Apr. to May.—*A. cærúlea*, Lenol.—*A. concínna*, DC. 20 ft.; fls. white. E. Indies. Stove.—*A. Concordiàna*, Loud.=Pithecolobium umbellatum.—*A. conférta*, Cunn. Apr.—*A. cordàta*, a trade name, probably belongs to some other species.—*A. coriácea*, DC. 5 ft. May.—*A. coronillæfólia*, Desf. 10 ft. N. Afr. Stove.—*A. corymbòsa*, Hort. lists=(?).—*A. crassicárpa*, Cunn. 6 ft. May.—*A. cultràta*, Hort.—A. cultriformis.—*A. cuspidàta*, Cunn.=A. diffusa var. cuspidata.—*A. cyanophýlla magnífica*, Hort. lists=(?).—*A. cyenòrum*, Hook.=A. obscura.—*A. Daviesiæfólia*, Cunn. 6 ft. June.—*A. decípiens* var. *præmórsa*, Hort.* 3 ft. May. B.M. 3244.—*A. densifólia*, Benth.=A. aspera.—*A. dentífera*, Benth. Apr. B.M. 4032.—*A. dependens*, Cunn.=A. longifolia var. mucronata.—*A. détinens*, Burch. 3 ft. May. S. Afr.—*A. Dietrichiàna*, F. Muell.—*A. díptera*, Willd.=Prosopis juliflora.—*A. díptera*, Lindl.. Shrub.: fls.(?).—*A. díptera* var. *erióptera*, Graham. Sept. B.M. 3939.—*A. dissitifólia*, Benth.=a form of A. longifolia.—*A. divaricàta*, Willd.=Lysiloma Schiedeana.—*A. dolabrifórmis*, Colla=A. decipiens.—*A. Donkelàarii* is a trade name.=Mimosa(?).—*A. doratóxylon*, Cunn. *(Currawang), a beautiful small tree: fls. golden yellow.—*A. dumòsa*, Wight &. Arn.=A. latronum.—*A. echínula*, DC.=A. juniperina.—*A. édulis*, Humb. & Bonpl.=A. Farnesiana.—*A. emarginàta*, Wendl.=A. stricta.—*A. eriocládа*, Benth. June.—*A. Esterhàzia*, Mackay. 4 ft. May.—*A. falcifórmis*, DC.=A. penninervis var. falciformis.—*A. ferrugínea*, DC. From E. Indies. Stove.—*A. flexicàulis*, Benth.=Pithecolobium flexicaule, Coulter.—*A. floribúnda*, Willd.=A. longifolia var. floribunda.—*A. floribùnda*, Hort.=A. neriifolia.—*A. formòsa*, Kunth.=Calliandra formosa.—*A fràgrans*, Tenore=Albizzia fragrans ("Acacia fragrance" Hort.?).—*A. frondòsa*, Willd.=Leucæna glauca.=A. fruticòsa, Mart.=Piptadenia latifolia.—*A. genistæfólia*, Link=A. diffusa.—*A. giráffæ*, Willd. (Camel-thorn). 40 ft. S. Afr. Fls.(?). Stove.—*A. glaùca*, Hort.=A. glaucescens.—*A. grándis*, Henfr.=A. pulchella var. grandis.—*A. gràta*, Willd.=Piptadenia macrocarpa.—*A. gravèolens*, Cunn.=A. verniciflua.—*A. guayaquilénsis*, Desf.=Mimosa guayaquilensis.—*A. guianénsis*, Willd.=Stryphnodendron guianense.—*A. gummífera*, Willd. 30 ft. Guinea. Fls.(?).—*A. Hæmatóxylon*, Willd. 20 ft. Fls. yellow or white. S. Afr. Stove.—*A. hastulàta*, Smith. 4 ft. May. B.M. 3341.—*A. heteracántha*, Burch. 15 ft.; fls.(?). S. Afr.—*A. heterophýlla*, Willd. 5 ft. May. Mascarene Isls.—*A. híspida*, Hort.=Robinia hispida.—*A. hispidíssima*, DC.=A. pulchella var. hispidissima.—*A. holosericea*, A. Cunn.—*A. homalophýlla*,* "Yarran."—*A. homatophýlla*, probably clerical error for A. homalophylla.—*A. homomálla*, Wendl.=A. glaucescens.—*A. hórrida*, Willd. S. Afr.— *A. Huegélii*, Benth.* Pale yellow. Feb.—*A. humifúsa*, Cunn. Austral.—*A. hýbrida*. Lodd.=A. armata.—*A. imperiàlis*, Hort. lists=(?).—*A. intermèdia*, Cunn.=A. longifolia var. floribunda.—*A. intertéxta*, Sieb.=A. longifolia.—*A. Intsia*, Willd.=A. cæsia.—*A. Jònesii*, F. Muell. Racemes simple, longer than lvs. which somewhat resemble those of green.-lvd. A. dealbata.—*A. Julibrissin*, Willd.=Albizzia Julibrissin.—*A. Kalkòra*, G. Don.=Albizzia Julibrissin.—*A. Lambertiàna*, D. Don.=Calliandra Lambertiana.—*A. lanígera*, Cunn. 6 ft. Apr. B.M. 2922.—*A. latifólia*, Benth.—*A. latisíliqua* Willd.=Lysiloma latisiliqua.—*A. Latròbei*, Meisn.=A. acinacea—*A. latrònum*, Willd. (A. dumosa, Wight & Arn.). Up to 20 ft.; E. Indies. Stove.—*A. laurifólia*, Willd. 4 ft. May. Pacific Isls. Stove.—*A. Lébbeck*, Willd.=Albizzia Lebbek.—*A. leiophýlla*, Benth.=A. saligna.—*A. lentiscifólia*, Desf. 20 ft.: fls.(?). Mex. Stove.—*A. leprósa*, Sieb.* May. B.R. 1441. "Graceful, linear leaves, and habit of a willow."—*A. leprósa* var. *tenuifólia*, Benth. Stove.—*A. leptocárpa*, Cunn. 6 ft. Apr.—*A. leptóclada*, Cunn.—*A. leptoneùra*, Benth. 6 ft. Apr. B.M. 4350.—*A. leptophýlla*, DC.=A. Farnesiana.—*A. leucocéphala*, Link=Leucæna glauca.—*A. leucophlœa*, Willd. 12 ft.; palc yellow. Trop. Asia. Stove.—*A. leucophýlla*, Colvill.=A. holosericea.—*A. ligulàta*, Cunn.=A. salicina.—*A. longifólia* var. *mucronàta*, F. v. M. (A. dependens, Cunn. A. mucronata, F. v. M.). March. B.M. 2747.—*A. longíssima*, Wendl.=A, linearis.—*A. lophántha*, Willd.=Albizzia lophantha.—*A. lophántha* var. *gigantèa*, Hort.=Albizzia lophantha var. gigantea.—*A. lùcida*, Baill.=Albizzia lucida.—*A. Mángium*, Willd. 10 ft. Molucca Isls. Stove.—*A. microphýlla*, Willd.=Piptadenia peregrina.—*A. móllis*, Wall.=Albizzia Julibrissin.—*A. Nèmu*, Willd.=Albizzia Julibrissin.—*A. neurocárpa*, Cunn.=A. holosericea.—*A. nigricans*, R. Br. 6 ft. Apr. B.M. 2188.—*A. notábilis*, F. Muell.—*A. nudifólra*, Willd. (A. Robriana, DC.). 30 ft.; white. W. Indies. Stove.—*A. obscùra*, DC. (A. cycnorum, Hook.). 2½ ft. B.M. 4653.—*A. odoratíssima*, Willd.=Albizzia odoratissima.—*A. oleæfólia*, Cunn.=A. lunata.—*A. oligophýlla*, Hoffmgg. 4 ft. Habitat(?). Stove.—*A. ornàta* is a name in the trade, probably of some well-known species.—*A. paradóxa*, DC.=A. armata.—*A. pentadènia*, Lindl. 10 ft. May. B.R. 1521.—*A. pinifólia*, Benth.=A. juncifolia,—*A. prinnàtissima*, Link.=A. tamarindifolia.—*A. platyphýlla*, Sweet. 10 ft. June.—*A. plumòsa*, Lowe. 20 ft. Brazil. B.M. 3366. A stove climber.—*A. podalària*, Hort. lists=(?).—*A. polybótrya*, Benth.* A beautiful pinnate-lvd. species.—*A. portoricénsis*, Willd.=Calliandra portoricensis.—*A. primòsa*, probably clerical error for A. pruinosa.—*A. prismática*, Hoffmgg. 6 ft. Habitat(?). Stove.—*A. prominens*, Cunn.=A. linifolia var. prominens.—*A. Pseudacácia*, Hort.=Robinia Pseudacacia.—*A. pulchérrima*, Willd.=Stryphnodendron floribundum.—*A. pyramidàlis*, Hort. lists=(?).—*A. quadran-*

gulàris, Link.=Calliandra tetragona.—*A. Reimerii*, local name for variety intro. by Reimers into San Francisco.—*A. ripària*, HBK. (A. sarmentosa, Griseb.). 10 ft. W. Indies. A stove climber.—*A. Rohriàna*, DC.=A. nudiflora.—*A. ròsea*, Hort.=Rohinia hispida.—*A. ruscifòlia*, Cunn.=A. verticillata var. latifolia.—*A. sarmentòsa*, Griseb.=A. riparia.—*A. scándens*, Willd.=Entada scandens.—*A. semicordàta*, Roxbg. 40 ft.: fls.(?). E. Indies. Stove.—*A. Sénegal*, Willd. 30 ft.: fls. white. Trop. W. Afr. Stove.—*A. sericàta*, Cunn. Apr.—*A. Sïmsii*, Cunn. Apr.—*A. Sophòræ*, R. Br.=A. longifolia var. Sophoræ.—*A. speciòsa*, Willd.=Albizzia Lebbek.—*A. spectábilis*, Cunn.* Apr. B.R. 1843:46. Remarkably beautiful.—*A. Spìni*, Balh. 15 ft.; red and yellow. Guadeloupe Isl. Stove.—*A. squamàta*, Lindl. Apr. Hook. Icon. Plant. 367.—*A. stenophýlla*, Cunn. March.—*A. stipulàta*, DC.=Albizzia stipulata.—*A. stolonífera*, Burchell, a species from S. Afr. with underground sts.—*A. stricta*, Willd. (A. emarginata, Wendl.). 2 ft. March. B.M. 1121.—*A. strigòsa*, Link (A. ciliata, R.Br.). 4 ft.—*A. strombulífera*, Willd.=Prosopis strombulifera.—*A. subulàta*, Bonpl. 4 ft. May.—*A. sulcàta*, R. Br. 2 ft. July. B.R. 928.—*A. Sùma*, Gurz. 10 ft.: fls.(?) E. Indies. Stove.—*A. tamarindifòlia*, Willd. (A. pinnata). 4 ft.: white. S. Amer. Stove.—*A. taxifòlia*, Lodd.=A. Riceana.—*A. tomentòsa*, Willd. 20 ft.: fls.(?). E. Indies. Stove.—*A. trichòdes*, Willd.=Leucæna trichodes.—*A. trinervàta*, Sieb. 6 ft. Apr.—*A. tristis*, Graham=A. armata.—*A. umbellàta*, Cunn. Apr.—*A. uncinàta*, Lodd.=A. undulæfolia.—*A. undulæfòlia* (A. uncinata., Lodd). 4 ft. May. B.M. 3394.—*A. urophýlla*, Benth. Pale yellow. Apr. B.M. 4573.—*A. vàga*, Willd. 40 ft.: white. Brazil. Stove.—*A. venùsta*, Willd.=Calliandra portoricensis.—*A. vèra*, Willd.=A. arabica.—*A. vernicíflua*, Cunn. (A. graveolens, Cunn. A. virgata, Lodd.). 6 ft. Apr. B.M. 3266, 3279.—*A. verticillàta* var. *angùsta*, Hort. 10 ft. Apr.—*A. verticillàta* var. *latifòlia*, Benth. (A. ruscifolia, Cunn. A. moesta, Lindl.). 10 ft. Apr. B.M. 3195. B.R. 1846:67.—*A. vestìta*, Ker-Gawl.* 6 ft. June. B.R. 698.—*A. viminàlis*, Ait. Apr.—*A. vir ëscens*, DC. 20 ft. S. Amer. Stove.—*A. virgàta*, Lodd.=A. verniciflua.—*A. viridiràmis*, Burch.=Xerocladia Zeyheri.—*A. viscídula*, Cunn. 6 ft. Feb. Gt. 1109. *A. viscòsa*, Schrad.=A. dodonæifolia.—*A. vomerifórmis*, Cunn. Apr.—*A. Wallichiàna*, DC.=Catechu.

KATHERINE D. JONES.

ACACIA, FALSE: *Robinia Pseudacacia.*

ACACIA, ROSE: *Robinia hispida.*

ACÆNA (from Greek word signifying *thorn*). *Rosàceæ.* NEW ZEALAND BUR. Trailing, more or less evergreen plants used in rockwork and as ground cover under trees and between other plants.

About 40 species of sub-shrubs or herbs of the southern hemisphere, allied to Agrimonia and Sanguisorba: lvs. unequally pinnate, alternate, the lfts. toothed or cut: fls. small, crowded in erect terminal spikes or heads; petals none; calyx 5–7-lobed, usually armed with spines; stamens 1–10, or even more: fr. an achene, 1 or 2 being enclosed in the hardened calyx.

77. Acalypha hispida (A. Sanderi).

Acænas are little grown in this country, but are prized in England as groundwork for dwarf spring-flowering bulbs, as trilliums; also useful in protecting native orchids and bog plants. Propagation is by cuttings, divisions and seeds.

Buchánanii, Hook. f. Plant usually densely or silky pale gray, the numerous sts. and branches lying very close on the ground: lvs. 1 in. or less long, the lfts. 3–6 pairs, very broad, finely serrate: fls. in small sessile heads; spines or bristles 4, yellow and hairy or barbed, the fruiting calyx broader than long. New. Zeal.

microphýlla, Hook. f. Plant glabrous or only sparingly silky, often making very large patches: lvs. pale, 2 in. or less long; lfts. 3–6 pairs, broad, deeply cut: fls. in globose stalked heads; fruiting calyx broader than long, the red spines attractive all summer and autumn. New Zeal.—Grows well in either wet or dry soils.—Var. **inérmis,** Kirk (*A. inérmis*, Hook. f.), has longer lvs. and the fruiting calyx without spines or bristles.

ovalifòlia, Ruiz & Pav. Lvs. a little larger than the last; lfts. oblong, subcuneate. Chile. Gn. 52, p. 46.

adscéndens, Vahl. Plant usually glabrous bronzy, the sts. stout and prostrate, the leafy branches ascending at the tips: lvs. 2–4 in. long: lfts. 4–6 pairs, ovate or obovate, deeply toothed: fls. in stalked heads; calyx-tube longer than broad, the spines 4 and stout. New Zeal., S. Amer.—Apparently the plant in the trade under the name of *A. adsurgens.*

A. argéntea, Ruiz & Pav. Lvs. silvery. Chilean Andes.—*A. myriophýlla*, Lindl. Fern-like: lfts. deeply cut: fls. green, Chile.—*A. novæ-zeelándiæ*, Kirk. Prostrate, silky: lfts. oblong, coarsely serrate: heads globose, stalked: bristles reddish purple: achene narrowed both ways. New Zeal.—*A. ovìna*, A. Cunn. Said to be much like A. ovalifolia, but larger and less graceful: fls. purple, in long spikes. Austral.—*A. Sanguisórbæ*, Vahl. Prostrate, silky: lfts. broad, toothed or serrate: heads globose, stalked; bristles long and barked, at each angle of calyx: achene broadest near base and narrowing upward; one of the troublesome sheep-burs. New Zeal.—*A. sarmentòsa*, Carmich.=A. Sanguisorbæ.

L. H. B.

ACALÝPHA (a name given by Hippocrates to a nettle). *Euphorbiàceæ.* COPPER-LEAF. THREE-SEEDED MERCURY. Brilliant tender foliage shrubs or herbs much used for greenhouse ornament, and especially for bedding-out; and in Florida and southward for lawn shrubs and hedges.

The acalyphas are erect shrubs or, in the native species, rather weedy herbs, with alternate stipulate lvs: fls. in spikes or spike-like racemes, the staminate cluster peduncled, each fl. in the axil of a minute bractlet, with a 4-parted calyx and 8-16 stamens; pistillate fls. subtended by a foliaceous bractlet, the calyx 3–5 parted; petals wanting in both kinds of fls., the long spike-like ament being the showy part of the fls.: fr. usually of 3–2-valved carpels, each 1-seeded.

For bedding, it is desirable to have strong, well-hardened plants in 4-inch pots, which should be set out the last week in May, and grown in a rich, moist soil without check. The leading horticultural species is *A. hispida.* The main point in the cultivation of this species is that it can be grown either to a single stem or in a spreading bush form, both of which ways are effective. Stock plants of acalypha do well in a mixture of three parts loam, one part well-decomposed manure, and, if the loam is heavy, also some sharp sand. In central Florida, none of the acalyphas is quite hardy. They should be banked late in the fall with dry sand, which must be removed when all danger of frost is over.

Propagation is by cuttings, chiefly in three ways: (1) in fall from outdoor bedded plants; (2) from plants lifted in fall, cut back, and kept for spring stock; (3) from stock plants in pots reserved from the previous season. The well-ripened wood of these last is a great advantage, and gives cuttings that may be taken with a heel. A mature stem will furnish several [illegible] he

top one. This is the best method for general purposes. Cuttings may also be taken below the joints when the shoots are half mature. The cuttings require mild bottom heat. For greenhouse ornament in fall and winter, excellent specimens may be secured from cuttings made in summer from such stock plants.

78. Acalypha Wilkesiana var. Macafeana. (× ⅛)

The acalyphas are subject to mealy-bug, scale and red-spider. For the first two, fumigate with hydrocyanic acid gas. The red-spider can be kept in check by syringing or spraying.

A. *Annual.*

índica, Linn. An erect hairy plant 1–3 ft.: lvs. broad, ovate, the petiole longer than the blade: fls. greenish, the spikes 1–2 in. long. Old World tropics.—Not showy. The hort. name *A. Miltoniana* may belong here.

AA. *Perennial.*

B. *Fl.-clusters much exceeding the lvs.*

híspida, Burm. f. (*A. Sánderi,* N. E. Br.). RED-HOT CAT-TAIL. Fig. 77. Cult. chiefly for its long red, amarantus-like spikes of fls. which are much longer than the lvs.: lvs. green. E. Indies. Burm. Fl. Ind., p. 303, t. 61, f.1. A.F. 13:1285. A.G. 19:453, 827. F.E. 10:554. G.C. III. 23:248. Gt. 47:276; 48:1465. Gn. 54:62. Gng. 6:279. B.M. 7632. R.H. 1898:456. —A very striking garden plant. Called by various names, as Chenille Plant, Philippine Medusa, and others. Var. **ramòsa,** Hort., has upper spikes branched or compound. Var. **álba,** Hort., spikes creamy white.

BB. *Fl.-clusters shorter than, and usually half hidden by the lvs.: branches not spiny.*

Wilkesiàna, Muell. Arg. (*A. tricolor,* Hort. ex Seem.). Lvs. ovate-acuminate, bronzy green, variously mottled with red: fls. usually some shade of red, inconspicuous. S. Sea Isls. Var. **Macafeàna,** Hort. Fig. 78. Lvs. red, marked with crimson and bronze.—Perhaps the commonest variety. R.H. 1882:288. Var. **macrophýlla** (*A. macrophýlla,* Hort., not HBK.). Lvs. cordate, ovate, russet-brown. Var. **marginàta,** Hort. Lvs. with marked crimson margin. F.M. 1875:156. Gn. 7, p. 521. I.H. 24:275. Var. **musàica,** Hort. Lvs. green, with orange and red markings. Var. **obovàta,** Hort. Lvs. obovate, green, edged white when young, changing to bronzy green with rosy pink margins. Var. **triúmphans,** Hort. (*A. triúmphans,* Lind. & Rod.). Lvs. large, spotted with crimson, green, and brown. I.H. 35:55 (1888).

integrifòlia, Willd., not Bojer (*A. coloràta,* Spreng. *A. Commersoniàna,* Baill.). Shrub, 4–6 ft.: lvs. oblong-fiddle-shaped, variable in size, crenate or entire, green above, purplish beneath: fls. small, the clusters shorter than the lvs. Mauritius and Madagascar.

Godseffiàna, Mast. Low-growing shrub of dense bushy habit: lvs. short-petioled, ovate or ovate-lanceolate, cordate, acuminate, coarsely toothed, green with a prominent cream-colored margin: fls. inconspicuous, greenish-yellow, the clusters shorter than the lvs. Apr., May. New Guinea. G.C. III. 23:242. Gng. 6:278. F.E. 10:554. A.F. 13:1286. Var. **heterophýlla,** Hort. Lvs., especially the lower, linear-lanceolate, irregularly repand.

BBB. *Fl.-cluster as in* BB, *but branches spiny.*

Var. **eremòrum,** Muell. Of peculiar habit and with spiny branches: lvs. green, short-petioled, crenate: fls. in spikes, the clusters shorter than the lvs. Austral.—Coolhouse plant, chiefly interesting botanically.

A. Chantrièri, Hort.=A. Hamiltoniana × Wilkesiana var. macrophylla.—*A. marginàta,* Hort., not Spreng.=A. Wilkesiana var. marginata.—*A. obovàta,* Hort., not Benth.=A. Wilkesiana var. obovata. Other trade names are *A. Hamiltoniàna,* Hort. Bruant 1895. Lvs. bright green, the rounded teeth yellow-margined.—*A. Miltoniàna,* Hort. Intro. 1911. *A. mortfontanénsis,* Hort.=A. Hamiltoniana × Wilkesiana var. marginata. *A. tórta,* Hort. Lvs. dark green, the margins cut into blunt oblong segms. Samoan Isls.

N. TAYLOR.†

ACÁMPE (named from the brittle nature of the flower). *Orchidàceæ.* Greenhouse epiphytes.

A. longifòlia, Lindl. (Vanda longifolia, Lindl.). E. Indies. A plant of no decorative value, and rarely, if ever, seen in cult.

ACANTHEPHÍPPIUM: *Acanthophippium.*

ACANTHOCÈREUS (Greek, *thorn* and *cereus*). *Cactàceæ.* An erect or clambering night-flowering cactus, the sts. elongated, usually 3-angled, but young shoots very diverse and sometimes 8-ribbed, never producing aërial roots; areolæ remote, bearing prominent spines: fls. large, funnelform: fr. a berry, sometimes with spines; flesh red; seeds black.—Perhaps several species, but some authors recognize only one species.

pentagònus, Brit. & Rose (*Cáctus pentagònus,* Linn. *Cèreus prínceps,* Pfeiff. *C. baxaniénsis,* Karw. *C. variábilis,* Engelm.). Half erect, 3–20 ft. high: spines 4–6, the longer 1½ in. long: fls. 7–8 in. long. Trop. Amer.—This species grows wild in S. E. Texas and does well there as a garden plant. It is also a common greenhouse plant where it does well, often growing to considerable size. It blooms freely, but the fls. are not very attractive.

J. N. ROSE.

79. Acantholimon glumaceum.

ACANTHÒDIUM: *Blepharis.*

ACANTHOLÌMON (*akanthos,* spine, and *limon,* sea lavender). Syn., *Armeriástrum. Plumbaginàceæ.* PRICKLY THRIFT. Hardy evergreen perennials, sometimes a little woody.

Leaves stiff, linear, round or slightly 3-angled, the angles channeled, the apex nearly always sharp-pointed: scape and peduncle nearly always simple, sometimes a little branched: fls. usually between and half hidden by the numerous bracts of the tightly compressed heads, spikes or racemes; corolla rose or white,

the petals at the base united to form a ring around the stamens; calyx tubular, the tube 10-ribbed. Boissier describes 74 species in the Flora Orientalis. See A. Bunge, Die Gattung Acantholimon, St. Petersburg, 1872.

The acantholimons are dwarf, tufted herbs, with sharp-pointed, rigid leaves; less common than Statice and Armeria, from both of which it is distinguished by its sharp-pointed leaves. An oriental genus of slow-growing and sun-loving plants for rockeries and sandy places. Most of them can be grown in the open border, *A. glumaceum* particularly, but they prefer warm, sunny situations in the rock-garden.

Propagation is best effected by cuttings taken in late summer and kept in a coldframe, protected from the frost, over winter. Layering is also a quicker method of propagation.

acerôsum, Willd. Woody, low perennial, with glaucous, spotted foliage: lvs. thick, 2–3 in. long, long-pointed, flatly 3-angled, the margins rough: scape longer than the lvs., topped by a laxly many-spiked fl.-cluster; petals white. E. Medit. region.—Most suitable for rock-garden. Scarcely grown in Amer.

80. Acanthopanax ricinifolium. (×⅓)

glumàceum, Boiss. (*Státice Ararátii,* Hort.). Fig. 79. Height 6 in.: lvs. green: fls. small, rose, on 1-sided spicate racemes, 6–9 in each short, dense racemelet. July–Sept. Armenia. F.S. 7:677. Gn. 31:350. R.H. 1891, p. 489.

venûstum, Boiss. (*Armeriástrum dianthifôlium,* O. Kuntze). About 8 in.: lvs. gray-green, very stiff: fls. larger than the last, rose, 12–20 in each long, loose spikelet. July–Sept. Asia Minor. R.H. 1866:450. Gn. 13:186. B.M. 7506. Gn. 53, p. 405.

A. Kótschyii, Boiss. Fls. white, rising well above the lvs. Cilicia. —*A. melanánthum,* Boiss. Short dense spikes; sepals violet or blackish-margined. Persia. N. Taylor.†

ACANTHOMÍNTHA (from Greek words for a *prickle* or *thorn,* and *mint*). *Labiàtæ.* Thorny Mint. A genus of only 2 species of tender annuals, with the habit of Lamium. Its chief interest is botanical, the nearest relative of the genus being the Brazilian genus Glechon. Calyx tubular-campanulate, 13-nerved, and with the calyx teeth all spinulose-tipped; corolla exceeding the calyx. Prop. by seeds in spring under glass.

ilicifôlia, Gray. Height 6 in.: lvs. petioled, ovate, coriaceous, coarsely crenate-dentate: fls. 3–8 in a whorl, chiefly rose or purplish rose, with yellow and white marks. Calif. B.M. 6750. Intro. 1891.—Less desirable than *Lamium,* which see. N. Taylor.†

ACANTHONÈMA (Greek combination referring to the spinous processes on the filaments). *Gesneràceæ.* A monotypic genus, comprising **A. strigôsum,** Hook. f., from Trop. Afr., closely resembling Streptocarpus: hothouse perennial with small fls. dark purple on the limb and otherwise white, in panicles 2 in. or less high arising from the base of the solitary prostrate narrowly oblong lf.

ACANTHÓPANAX (*acanthos,* thorn, and *panax,* a prickly panax-like plant). *Araliàceæ.* Including *Kalopànax* and *Eleutherocóccus.* Hardy trees or shrubs, cultivated chiefly for their ornamental foliage.

Branches and sts. usually prickly: lvs. alternate, long-petioled, palmately lobed or digitate, deciduous: fls. small, usually greenish, perfect or polygamous, in umbels, sometimes forming large terminal panicles; calyx-teeth minute; petals and stamens 5, rarely 4; ovary 2–5-celled; styles 2–5, free or connate: fr. a black, 2–5-seeded berry.—More than 15 species in Cent. and E. Asia and in the Himalayas.

The members of this genus are trees or large shrubs with stout, usually prickly branches and large, palmately lobed or digitate leaves, small greenish flowers in umbels, sometimes forming large terminal panicles, followed by small black berries.

For cultivation of Acanthopanax, see the genus Aralia. The species described below are hardy except *A. pentaphyllum,* which is tender north of Massachusetts, and *A. trifoliatum* and *A. setchuenense,* which are probably still more tender.

Propagation is by seeds, to be sown as soon as received, or stratified and sown in spring; they germinate irregularly and may lie two years; also propagated by root-cuttings with bottom heat, and by soft-wood cuttings taken from forced plants; *A. pentaphyllum* grows also from cuttings of ripened wood.

A. *Lvs. simple, palmately lobed.*

ricinifôlium, Seem. (*Kalopànax ricinifôlium,* Miq. *A. ricinifôlium* var. *magníficum,* Zabel. *A. acerifôlium,* Schelle). Fig. 80. Sparingly branched tree, to 80 ft.: branches and sts. with numerous stout prickles: lvs. 5–7-lobed, 9–14 in. in diam., lobes triangular-ovate, acuminate, serrate, glabrous or nearly so: infl. compound, terminal, large; styles 2, nearly connate. Japan. S.I.F. 2:56. G.W. 11:537. Var. **Maximowíczii,** Schneid. (*Aràlia Maximowiczii,* Van Houtte). Fig. 81. Lvs. deeply 5–7-lobed, with oblong-lanceolate lobes, downy beneath. Japan. F.S. 20:2067. M.D.G. 1897: 233.—Very ornamental trees of striking subtropical effect.

AA. *Lvs. digitate.*

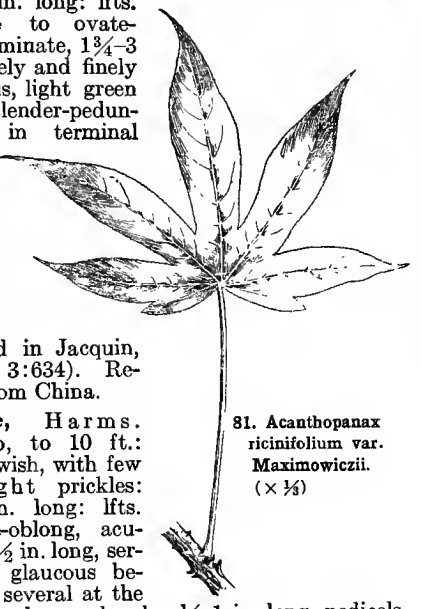
B. *Fls. short-pedicelled.*

sessiliflôrum, Seem. (*Pànax sessiliflôrum,* Rupr. & Max.). Shrub with stout upright branches, to 12 ft.: branches with only few prickles: lfts. mostly 3, obovate-lanceolate or oblong-lanceolate, cuneate, acuminate, 3–7 in. long, irregularly crenate-serrate, nearly smooth: fls. dull purplish, nearly sessile, in globular heads on stout, downy peduncles, usually several at the end of the branches. Manchuria, N. China. G.C. III. 22:339. Gt. 11:369.—The freely produced heads of black berries are decorative. Var. **párviceps,** Rehd. Lower and denser: lvs. elliptic, 2–3 in. long: heads smaller, usually solitary.

BB. *Fls. slender-pedicelled.*

C. *Lvs. usually 3-foliolate.*

trifoliàtum, Schneid. (*Zanthóxylum trifoliàtum,* Linn. *A. aculeàtum,* Seem. *A. sépium,* Seem.). Climbing shrub, to 20 ft.: branches with few hooked spines: petiole 1–1½ in. long: lfts. stalked, ovate to ovate-lanceolate, acuminate, 1¾–3 in. long, remotely and finely serrate, glabrous, light green beneath: the slender-peduncled umbels in terminal whorls; pedicels slender; styles 2, connate to the middle. China, Himalayas. L.B.C. 10:977 (infl. abnormal; a better figure is found in Jacquin, Icon. Pl. Rar. 3:634). Recently intro. from China.



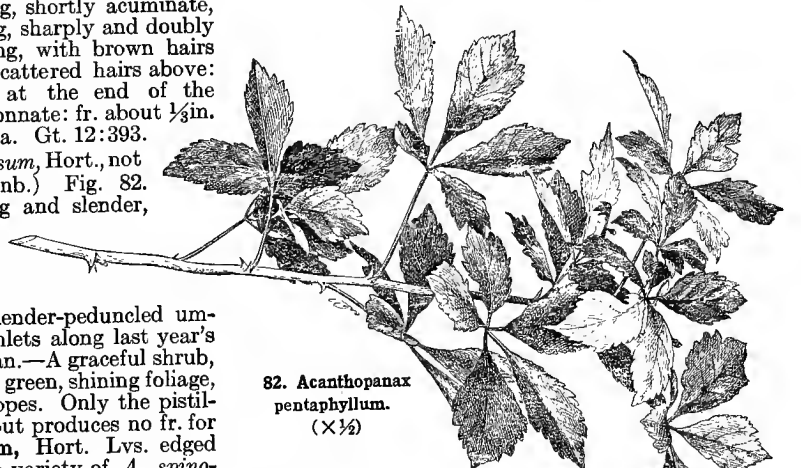
81. Acanthopanax ricinifolium var. Maximowiczii. (× ⅓)

setchuenénse, Harms. Upright shrub, to 10 ft.: branches yellowish, with few nearly straight prickles: petiole 2–4 in. long: lfts. stalked, ovate-oblong, acuminate, 2½–3½ in. long, serrate, glabrous, glaucous beneath: umbels several at the end of the branches, peduncles ½–1 in. long, pedicels slender; ovary 5-celled, styles connate into one. W. China.

CC. *Lvs. 5–7-foliolate.*

senticòsum, Harms (*Eleutherocóccus senticòsus,* Maxim.). Shrub, to 15 ft.: branches upright, densely covered with slender prickles: lfts. 5, occasionally 3, stalked, elliptic-obovate to oblong, shortly acuminate, narrowed at the base, 3–5 in. long, sharply and doubly serrate, bright green; when young, with brown hairs on the veins beneath and with scattered hairs above: umbels long-peduncled, several at the end of the branches; ovary 5-celled, styles connate: fr. about ⅓ in. long. July. N. China, Manchuria. Gt. 12:393.

pentaphýllum, Marsh. (*A. spinòsum,* Hort., not Miq. *Aràlia pentaphýlla,* Thunb.) Fig. 82. Shrub, 5–10 ft.: branches arching and slender, with few compressed, straight prickles: lfts. 5–7, oblong-obovate or oblong-lanceolate, cuneate, acute, ¾–1½ in. long, crenate-serrate, smooth: fls. green, in slender-peduncled umbels, solitary on spur-like branchlets along last year's branches; styles 5, connate. Japan.—A graceful shrub, with arching branches and bright green, shining foliage, excellent on rocky banks and slopes. Only the pistillate form seems to be in cult., but produces no fr. for want of pollen. Var. **variegàtum,** Hort. Lvs. edged white. F.S. 20:2079.—Possibly a variety of *A. spinosum.* Also *A. quinquefolium variegatum,* Veitch Cat., may be the same.



82. Acanthopanax pentaphyllum. (×½)

A. divaricàtum, Seem. Allied to A. sessiliflorum. Lfts. 5, downy beneath: fls. pedicelled. Japan. S.I.F. 2:56.—*A. Hénryi,* Harms (Eleutherococcus Henryi, Oliver). Allied to A. sessiliflorum. Branches with few hooked prickles: lfts. 3–5, nearly sessile, cuneate at the base, oblong, 2–3 in. long: fls. pedicelled. Cent. China. B.M. 8316.—*A. innovans,* Franch. & Sav. Unarmed small tree: lvs. fascicled 3-foliolate, occasionally 2-foliolate or undivided and cordate; lfts. nearly sessile, glabrous: umbels paniculate. Japan.—*A. leucorrhizum,* Harms. Allied to A. senticosum. Branches only below the petiole with several straight reflexed prickles: lfts. oblanceolate, glabrous: umbels solitary or few. Cent. China.—*A. sciadophylloides,* Franch. & Sav. Unarmed tree, to 40 ft.; lfts. 5, stalked, nearly glabrous: umbels forming large terminal panicles. Japan. S.I.F. 2:55.—*A. Simònii,* Schneid. Allied to A. senticosum. Branches with several prickles below the petiole: lfts. 5, prickly on both sides, oblong. China. M.D.G. 1910:25.—*A. spinòsum,* Miq. Allied to A. pentaphyllum. Lvs. often sparingly appressed-setose above: peduncles shorter than petioles; styles 2, separate. China.

ALFRED REHDER.

ACANTHOPHÍPPIUM (meaning unexplained). Sometimes spelled *Acanthephíppium. Orchidàceæ.* Stove terrestrial orchids.

Pseudobulbs conic or cylindric, of several internodes, with several large, plicate-veined, jointed lvs. at the apex: fls. borne on a lateral leafless scape, in a few-fld. raceme; the broad, fleshy sepals form an urn-shaped tube, which incloses the narrower petals and the lip; lip jointed to the apex of the short, thick column which is produced below into a foot to which the sepals and petals are attached; pollinia 8.—A genus of 4 species, natives of the E. Indies and Malay Archipelago.

These are very rarely seen in cultivation, but are warmhouse terrestrial orchids from the hottest moist shaded jungles of Java. A compost of fibrous loam and leaf-mold is best suited to them, keeping the plants in the warmest house in winter. Propagate by dividing the pseudobulbs in spring before growth has made much advancement. (Orpet.)

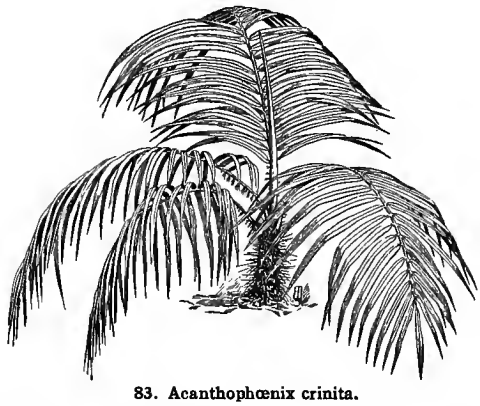
javánicum, Blume. Fls. yellow, flushed and striped with purplish red, the sepals and petals spreading at the tip. Java. J.F. 1:35. B.M. 4492.

A. bícolor, Lindl. Fls. yellow, tipped and marked with purple.—*A. Cúrtisii,* Reichb. Fls. light rose, flushed and striped with purple. The 5 keels between the side lobes serve to distinguish this from related species. Malay Archipelago.—*A. sylheténse,* Lindl. Fls. about 2 in. long, white. Himalayas.

GEORGE V. NASH. †

ACANTHOPHŒNIX (*acantha,* thorn, and *phœnix,* a date palm). *Palmàceæ,* tribe *Arèceæ.* Very elegant greenhouse palms.

Leaves pinnate, finely dissected, more or less armed with long, slender, brown or black spines; lfts. narrow, linear-lanceolate, acute, rarely acuminate, prominently veined above, scaly beneath, the margins revolute; rachis 3-angled in sections; sheath long, smooth or spiny: infl. (spadix) twice branched, sometimes smooth, but often hairy or even spiny, hanging by a short, stout stalk; the secondary branches slender or sometimes thick and twisted: spathes 2, flattened, soon falling: fls. monœcious, in spirally disposed 3-fld. clusters, red, pinkish or orange; inner segms. of the perianth valvate in male fls., imbricate in female fls.; stamens 12, reduced in the pistillate fls. to a ring of functionless staminoidea: fr. black, about twice the size of a grain of wheat.—There are only 3 or 4 species, confined



83. Acanthophœnix crinita.

exclusively to the Mascarene Isls., Mauritius and Bourbon. G.C. II. 22:426.

These are tall palms or sometimes of moderate stature, the spiny and often ringed trunks conspicuously swollen at the base. Horticulturally, they have not figured very prominently in the trade in this country, but they are among the finest of cultivated palms in the collections of fanciers and botanic gardens.

They should be grown in a warm house, from 70 to 90°, never less than a night temperature of 55 to 60°. They will root best in a soil composed as follows: loam three parts, peat one part, leaf-mold one part, mixed with a little sand or crushed charcoal. The drainage, so long as the plants are in pots and tubs, must be very good, as they require much water. If possible, when the plants are 6 feet or more, plant out permanently.

Propagation is only by seeds, which frequently require two to three years to germinate. The seeds should be placed in a seed-pan and kept in a warm, moist place.

crinìta, H. Wendl. (*Arèca crinìta,* Bory). Fig. 83. Trunk 50–60 ft.: lvs. 7–13 ft. long; petiole densely tomentose, 4–8 in. long; lf.-sheath 2½–4½ ft. long, thickly covered with short brown bristles and spines; segms. silvery white beneath: spadix 1–2 ft. long, brown, woolly and with slender brown spines; perianth reddish pink, or sometimes whitish: fr. ⅓–½in. long. F.S. 16:1706. F.R. 2:201.—Young plants have pale yellowish green lvs.

rùbra, H. Wendl. (*Arèca rùbra,* Bory. *Cálamus Verschaffèltii,* Hort.). Trunk 60 ft.: lvs. 6–12 ft. long; petiole glabrous, 2–4 in. long; lf.-sheath 2½–4½ ft. long, thickly covered with long, brown-black spines; pinnæ slightly glaucous beneath: spadix 2½–3½ ft. long, armed with straight black spines; perianth reddish brown: fr. globose. ⅓–⅜in. in diam., with a prominent ridge extending from the stigma to the base.—Young plants have dark green lvs. with red veins. N. Taylor. †

ACANTHORHÌZA (Greek for thorn, and *rhiza,* root). *Palmàceæ,* tribe *Corỳphеæ.* A genus of tropical American medium-sized palms.

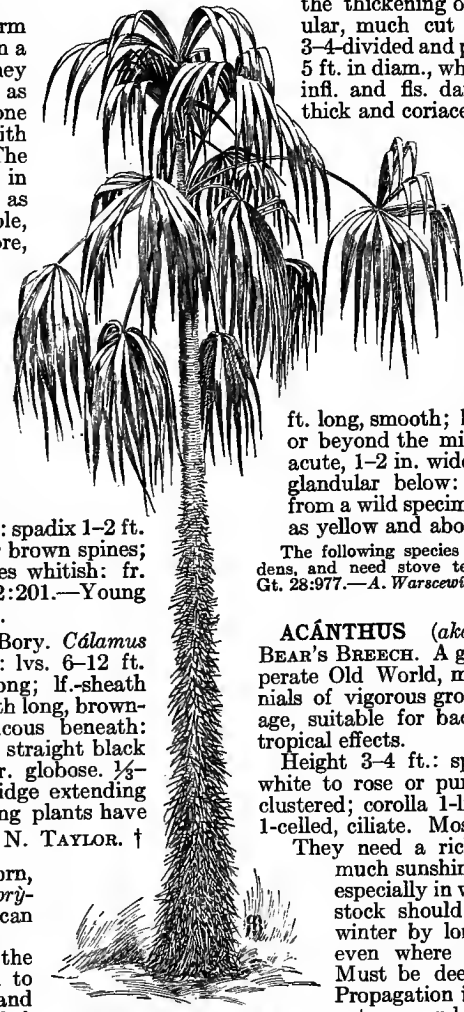
Leaves crowded at the end of the trunk, palmate, 3 to many, divided to the base, but the segms. stalkless, and in age becoming typically 3–4 divided, the segms. then wedge-shaped; lf.-stalk flattened, very persistent, slender and smooth, the sheath short and fibrous; as the lvs. unfold the margins are bent inward, the external faces applied together: infl. flattened at first, the short peduncle and thickening branches, white, bracteate, the bracts diminishing downward; fls. cream-white, in spike-like, dense clusters, these racemose; stamens quite free, differing from Trithrinax, where they are united to form a tube. It has never been known to fruit in cult.—Three or four species only, are known, all from Trop. Amer., but not so well known to the trade as their great beauty and stately dimensions deserve. G.C. II. 22:426.

These palms have spineless trunks, except at the base, where the aërial roots subsequently harden into stiff downward-pointing spines; differing in this from Trithrinax, the nearest relative.

They should be grown as stove palms, a night temperature not less than 60° being preferable. If possible, plant out the tall plants, as they do much better when not disturbed by subsequent repotting. A good mixture should contain good, fibrous loam and considerable sand.

Propagation is only by seeds, sown preferably in the spring, in fresh peat over bottom heat.

aculeàta, H. Wendl. (*Chamærops stauracántha,* Hort.). Fig. 84. St. 30–40 ft., spiny at base through the thickening of the aërial roots: lvs. orbicular, much cut in young trees, subsequently 3–4-divided and palmate in the older specimens, 5 ft. in diam., whitish beneath; lf.-stalk 3–4 ft.: infl. and fls. dark creamy pink; fls. spicate, thick and coriaceous; calyx lobes erect, oblong, equaling the roundish and concave petals. Mex. I.H. 26:367. B.M. 7302.—Succeeds in an intermediate house.



84. Acanthorhiza aculeata.

Chûco, Drude (*Thrìnax Chùco,* Mart.). Trunk smooth, about 30 ft. high, usually not more than 5 in. in diam., slender, flexuous: lvs. orbicular, with a narrow sinus at the base, usually 10–25 in a cluster; petioles slender, 3–6 ft. long, smooth; blade 6 ft. in diam., divided to or beyond the middle; segms. 15–20, lanceolate, acute, 1–2 in. wide, dark green above, paler and glandular below: fls. and fr. unknown, except from a wild specimen in which the fr. is described as yellow and about 1 in. diam. Brazil.

The following species are rarely seen outside botanic gardens, and need stove temperature: *A. Wállisii,* H. Wendl. Gt. 28:977.—*A. Warscewiczii,* H. Wendl. Panama. Gt. 25:860.

N. Taylor. †

ACÁNTHUS (*akanthos,* thorn). *Acanthàceæ.* Bear's Breech. A genus of twenty species of temperate Old World, mostly hardy herbaceous perennials of vigorous growth and broad pinnatifid foliage, suitable for backgrounds of borders and subtropical effects.

Height 3–4 ft.: spikes 1–1½ ft. long; fls. dull white to rose or purplish, sessile, spicate, densely clustered; corolla 1-lipped, the lip 3-lobed; anthers 1-celled, ciliate. Mostly S. Eu.

They need a rich, light, well-drained soil and much sunshine. Excessive moisture is fatal, especially in winter and spring. Fall-planted stock should always be protected for the winter by long litter or evergreen boughs, even where established plants are hardy. Must be deeply mulched north in winter. Propagation is by division in spring or early autumn, and by seeds.

It is supposed that acanthus leaves afforded the suggestion for the foliage decoration on the capital of the Corinthian and other columns. Fig. 85 shows the conventionalized decoration, and Fig. 86 the form of leaf of *A. spinosus*. The leaves of *A. mollis* were probably also involved in variations of decoration.

85. The Acanthus decoration of an architectural column.

A. *Lvs. spiny.*

Cároli-Alexándri, Hausskn. Nine to 18 in.: lvs. few, radical, in a lax rosette, lanceolate, spiny, 16 in. long, 3–3½ in. broad: spike dense; fls. white or suffused rose-color. Summer. Greece.

spinosíssimus, Desf. Fig. 87. Lvs. dark green, pinnately parted; spines glistening, whitish: fls. infrequent, rosy, sessile: autumn; spikes loose, pilose or glabrescent: spines of the bracts recurved. S. Eu. Grows 3–4 feet.

Pérringi, Siehe. About 1–1½ ft. high: lvs. sessile, 5–6 in. long, lanceolate tapering, deeply toothed and spiny: fls. very profuse, rosy red, its bracts spiny. Mts. of Turkey in Asia. June.—Suitable for alpine garden. Doubtfully hardy where summers are hot and dry.

spinósus, Linn. Fig. 86. Lvs. lanceolate, pinnatifid, pubescent; spines short, whitish: fls. smaller than in the last, purplish, summer; spikes dense, slightly villous. B.M. 1808. Gn. 8:147.

montânus, T. Anders. Lvs. pinnatifid or sinuate-spinose, 1 ft. or more long, olive-green, the lobes spine-pointed: fls. rosy white in a long spike. Trop. Afr.—Greenhouse.

AA. *Lvs. not spiny.*

móllis, Linn. Fig. 88. Lvs. 2 x 1 ft., cordate, sinuately pinnatifid, mostly radical: fls. summer; spikes loose, pubescent. Gn. 52, p. 239.—Also recommended as a window plant. Var. latifólius, Hort. (*A. latifólius*, Hort. *A. lusitánicus*, Hort.) is larger and hardier. Gn. 1, p. 303.

longifólius, Poir. Lvs. radical, longer and narrower than in *A. mollis*, bright green: fls. purple, June. Dalmatia.

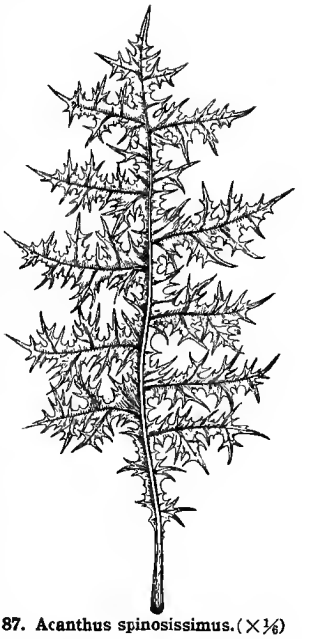
80 Acanthus spinosus. From drawing by John Ruskin.

A. arbóreus, Forsk. Evergreen prickly shrub attaining a height of nearly 20 ft. N. E. Trop. Afr. G.C. III. 31: 222.—*A. carduifólius*, Linn. = Blepharis carduifolia.—*A. hispánicus*, Hort. 2 ft.: lvs. large, deeply cleft, shining green: fls. white. Aug. Spain. Perhaps A. niger, Mill.—*A. ilicifólius* (Dilivaria ilicifolia, Juss.). Smooth greenhouse sub-shrub with lvs. resembling Ilex aquifolium, the Eu. Holly. Prop. by cuttings under glass. E. Asia.—*A. níger*, Mill. Lvs. not spiny, sinuate, glabrous: fls. purplish white. Portugal.

N. Taylor.†

ÀCER (classical Latin name). *Aceràceæ.* Maple. Native and foreign trees cultivated chiefly for shade and for the ornamental foliage.

Trees, rarely shrubs: lvs. opposite, petioled, simple and mostly palmately lobed, or 3–5 foliolate, deciduous, rarely evergreen: fls. small, polygamous or dicœcious, in racemes, panicles or corymbs; petals and sepals 5, rarely 4, rarely sepals connate and petals wanting; disk usually annular, conspicuous, rarely lobed or wanting; stamens 4–10, mostly 8; styles 2, usually more or less connate: fr. consisting of 2 long-winged, compressed nutlets (samaras), each containing 1 seed.—About 110 species in N. Amer., Asia, especially Cent. and E. Asia, Europe and N. Afr. Monogr. by Pax in Engler, Pflanzenreich IV, fam. 163 (1903), quoted below as Pax; see, also, Rehder, The Maples of E. Continental Asia, in Sargent, Trees and Shrubs, 1:175 (1905), and Koidzumi, Revisio Aceracearum Japonicarum in Jour. College of Science, Tokyo, 32, Art. 1 (1911), both with many plates. Monogr. of the garden forms by Graf Schwerin in Gt. 1893; see also G.C. II. 16:75.



87. Acanthus spinosissimus. (×⅛)

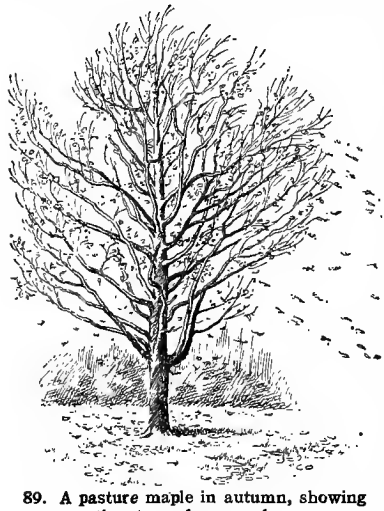
The maples are hardy ornamental trees or shrubs, with handsome large foliage which, in some species, shows a remarkable tendency to vary in shape and coloring. Numerous garden forms are in cultivation. Though the flowers are small, they are quite attractive in the early-flowering species as in *A. rubrum* and *A. saccharum*, since they appear in great profusion; in some species the young fruits assume a bright red color, particularly in *A. tataricum*, *A. ginnala*, *A. pseudoplatanus* var. *erythrocarpum*, and *A. rubrum*. The maples are among our most ornamental and valuable trees for park and street planting. Nearly all assume a splendid color in autumn, especially the species of North America and Eastern Asia, which surpass by far the European maples. Many species are valuable timber trees, and some American species, especially *A. saccharum*, produce sugar. For purposes of shade, the common sugar maple is best and most popular. The Norway maple makes a very dense and round head, and is excellent for lawns, but it is too low-headed for the streets. *A. pictum* is similar, but smaller in every part. The silver maple, *A. saccharinum* and its vars., is also popular where quick-growing trees are desired. The Japanese maples of the Palmata section are among the most striking and showy exotic small trees, and are adapted for fine grounds and for growing in pots.

The maples are not particular as to soil; some species, as *A. monspessulanum* and *A. campestre*, prefer drier situations, while *A. saccharinum* and *A. rubrum* prefer moist situations, the latter growing well even in swampy soil. Most of the species are hardy in the northern and middle states; among the hardiest are *A. Negundo*, *A. saccharum* (Figs. 89, 90), *A. saccharinum*, *A. rubrum*, *A. nigrum*, *A. pennsylvanicum*, *A. spicatum*, *A. platanoides*, *A. tataricum*.

88. Acanthus mollis. (×⅛)

Propagation is by

seeds, which soon lose their germinating power and must be sown soon after maturity or stratified and sown in spring; *A. saccharum* and *A. Negundo* keep their germinating power somewhat longer. The early-ripening species, like *A. saccharinum* and *A. rubrum*, must be sown as soon as they are ripe and they will germinate the same year. *A. campestre*, *A. monspessulanum* and other species of this group do not usually germinate until the second year. The varieties and rare species may be budded in summer on the typical forms or on species of the same group; kinds belonging to different groups cannot, as a rule, be grafted on each other; e.g., varieties of *A. platanoides* will not grow on *A. pseudoplatanus* and vice versa, but *A. insigne* will grow on *A. pseudoplatanus*, as they belong to the same group. Some shrubby species, as *A. palmatum*, also *A. cissifolium*, *A. ginnala* var. *Semenowi*, and *A. lævum* var. *rubrum*, may be propagated by layers or half-ripened greenwood cuttings in summer, or, still better, by cuttings taken from forced plants in early spring in the greenhouse. *A. Negundo* grows also from hardwood cuttings. Fancy maples are readily winter-grafted by the veneer method, the stocks being grown in pots. The Japanese kinds are usually worked on imported stocks of *A. palmatum*.



89. A pasture maple in autumn, showing the strong framework.

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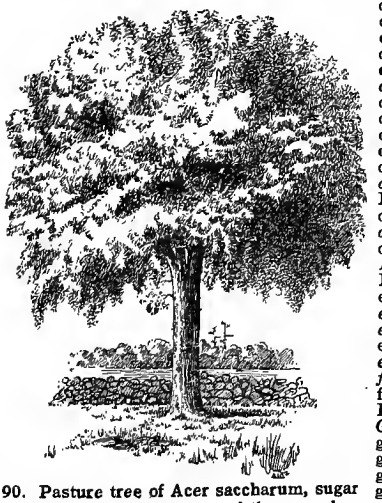

90. Pasture tree of Acer saccharum, sugar maple. Tree flatter-topped than usual.

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KEY TO THE SPECIES.

A. *Lvs. simple, mostly palmately lobed (occasionally 3-foliolate in No. 11).*
B. *Sepals and petals distinct (petals wanting in Nos. 27 and 35).*
C. *Fls. appearing with or after the lvs. in corymbs, panicles, or racemes.*
D. *Arrangement of infl. corymbose (broadly paniculate in No. 4).*
E. *Winter-buds with several imbricate scales: lobes entire or coarsely toothed, rarely lvs. without lobes.*
F. *Lobes obtuse or bluntly pointed.*
G. *Lvs. 1–3½ in. across, usually 3-lobed; lobes usually entire or with few teeth.*
H. *Corymbs glabrous: lobes entire, lvs. glaucous beneath* ..... **1. monspessulanum**
HH. *Corymbs pubescent, upright: lobes usually dentate, lvs. green beneath* ..... **2. campestre**
GG. *Lvs. 3–6 in. across, 3–5-lobed; lobes toothed.*
H. *Infl. corymbose, many-fld. pendulous: lvs. glaucescent beneath; lobes obtuse or acute* .. **3. Opalus**
HH. *Infl. paniculate, upright: lvs. green beneath and pubescent; lobes obtusely acuminate* ..... **4. Miyabei**
FF. *Lobes acuminate, finely pointed: corymbs glabrous.*
G. *Lvs. glabrous beneath, 5–7-, rarely 3-lobed: corymbs stalked.*
H. *Bark of mature branches ashy gray or light grayish brown, slightly fissured and marked with lenticels.*
I. *The lobes coarsely toothed* ..... **5. platanoides**
II. *The lobes entire or rarely with few teeth.*

JJ. *Wings about as long as nutlets: lvs. truncate at base:.* 6. **truncatum**

JJ. *Wings about twice as long as nutlets: lvs. cordate or subcordate.....* 7. **pictum**

HH. *Bark remaining smooth and lustrous for several years, without or with few inconspicuous lenticels, greenish or purplish.....* 8. **cappadocicum**

GG. *Lvs. pubescent beneath, usually 3-lobed, occasionally 5-lobed or quite entire: corymbs nearly sessile, very large.....* 9. **longipes**

FFF. *Lobes none or not prevalent, the lvs. quite entire, ovate to ovate-oblong, rarely mixed with a few 3–5-lobed lvs.: corymb nearly sessile, very large.....*10. **catalpifolium**

EE. *Winter-buds with 2 outer valvate scales: lobes serrate or doubly serrate: corymbs small.*

F. *Lvs. 3-lobed or 3-foliolate, occasionally 5-lobed, pale or glaucescent beneath, quite glabrous.....*11. **glabrum**

FF. *Lvs. 5–11-lobed, green beneath.*

G. *Petioles and peduncles glabrous: ovary glabrous.*

H. *Sepals purplish; petals white: lvs. lobed nearly to the middle.....*12. **circinatum**

HH. *Sepals and petals purplish: lvs. lobed beyond the middle.....*13. **palmatum**

GG. *Petioles and peduncles pubescent, at least while young: ovary villous.*

H. *Fls. yellowish: lvs. subcordate or cordate, sharply or doubly serrate.....*14. **Sieboldianum**

HH. *Fls. purple, larger: lvs. deeply cordate, incisely serrate.....*15. **japonicum**

DD. *Arrangement of infl. paniculate or racemose.*

E. *Infl. paniculate (nearly corymbose in No. 16).*

F. *Lvs. dentate or serrate, usually lobed.*

G. *Edges of lvs. sharply serrate.*

H. *Panicle only little longer than broad.*

I. *The lvs. 5-lobed, sharply and simply serrate.....*16. **Oliverianum**

II. *The lvs. 3-lobed or without lobes, doubly serrate.*

J. *Foliage dull green; lvs. ovate-oblong, not lobed .....*17. **tataricum**

JJ. *Foliage shining dark green: lvs. 3-lobed .....*18. **ginnala**

HH. *Panicle narrow, spike-like, upright: lvs. 3–5-lobed, doubly serrate: petals linear, much longer than the sepals.*

I. *Foliage pubescent beneath: lvs. 3-, rarely 5-lobed ....*19. **spicatum**

II. *Foliage glabrous or pubescent beneath: lvs. 5-, rarely 7-lobed ....*20. **caudatum**

GG. *Edges of lvs. coarsely or crenately dentate, 5-lobed.*

H. *Panicles pendulous, much longer than broad.*

I. *Fr. hispid: lvs. 10–12 in. long, deeply lobed.....*21. **macrophyllum**

II. *Fr. glabrous: lvs. 4–6 in. long.....*22. **pseudoplatanus**

HH. *Panicles upright, little longer than broad.*

I. *Blade with middle lobe free nearly to the base.....*23. **Heldreichii**

II. *Blade with lobes divided to the middle or little beyond.*

J. *Lobes longer than broad: lvs. glaucescent beneath..*24. **Trautvetteri**

JJ. *Lobes about as long as broad: lvs. green beneath...*25. **insigne**

FF. *Lvs. quite entire, generally oblong.....*26. **oblongum**

EE. *Infl. racemose.*

F. *Lvs. oblong, undivided, serrate, with about 20 pairs of parallel veins: winter-buds with many imbricate scales.*27. **carpinifolium**

FF. *Lvs. lobed or undivided, with about 10 pairs of veins or less: winter-buds with 2 outer valvate scales.*

G. *Sepals and petals 5; racemes terminal: lvs. brownish pubescent beneath while young, at least on the veins.*

H. *Outline of lvs. oblong, without lobes or with 2 lobes near the base.*

I. *The lvs. undivided, crenately serrate...*28. **Davidii**

II. *The lvs. lobed.*

J. *With lvs. green beneath, sharply serrate, long-acuminate, slightly lobed.....*29. **laxiflorum**

JJ. *With lvs. glaucescent beneath, unequally serrate, acuminate, often deeply lobed.....*30. **cratægifolium**

HH. *Outline of lvs. ovate or roundish, 5-lobed....*31. **Tschonoskii**

HHH. *Outline of lvs. obovate, 3-lobed, with the lobes near or above the middle.*

I. *Young branchlets bloomy: young lvs. densely brownish villous on the veins beneath: raceme pubescent.....*32. **rufinerve**

II. *Young branchlets not bloomy: young unfolding lvs. brownish villous on the whole under side, primary veins glabrescent: raceme often glabrous ....*33. **pennsylvanicum**

GG. *Sepals and petals 4; staminate fls. from lateral leafless buds: lvs. doubly serrate, 5-lobed or without lobes.*

H. *Lvs. undivided or incisely lobed, ovate to oblong.....*34. **tetramerum**

HH. *Lvs. distinctly 5-lobed, roundish in outline..*35. **argutum**

CC. *Fls. appearing long before the lvs. in dense lateral clusters: lvs. 5-lobed: fr. ripening in May or June.*

D. *Ovary and young fr. tomentose: short-stalked: lvs. deeply 5-lobed*.....36. **saccharinum**
DD. *Ovary and young fr. glabrous: fls. on long pedicels: lvs. 3–5-lobed*.....37. **rubrum**
BB. *Sepals connate and petals wanting at least in the staminate fls.; fls. on long, pendulous, mostly hairy pedicels.*
C. *Pistillate and staminate fls. corymbose, terminal and lateral:. fr. glabrous or villous. American species.*
D. *Corymb sessile or nearly sessile.*
E. *Lvs. glaucous or pale beneath.*
F. *Lobes acuminate; lvs. glabrous beneath at maturity*. 38. **saccharum**
FF. *Lobes obtuse; lvs. pubescent beneath*.....39. **floridanum**
EE. *Lvs. green beneath; lobes acuminate.*
F. *Bark of trunk dark: lvs. hirsute-pubescent, 5–6 in. across*.....40. **nigrum**
FF. *Bark pale: lvs. soft-pubescent beneath, 2–3½ in. across*..41. **leucoderme**
DD. *Corymbs short-stalked: lvs. pubescent beneath; lobes obtuse or acute*.....42. **grandi-**
CC. *Pistillate fls. racemose, with petals and distinct sepals, staminate corymbose, with connate sepals and without petals, both from lateral leafless buds. Japanese species*...43. **[dentatum diabolicum**
AA. *Lvs. 3–5-foliolate: fls. dioecious.*
B. *Fls. in terminal corymbs, after the lvs.: winter-buds with several imbricate scales: disk large, annular: lvs. 3-foliolate.*
C. *Petioles, lvs. beneath and corymbs pilose; petioles short.*
D. *Shape of lvs. elliptic-oblong, sparingly serrate, 2–5 in. long*....44. **nikoense**
DD. *Shape of lvs. elliptic, coarsely dentate, 1–2 in. long*.....45. **griseum**
CC. *Petioles, lvs. and corymbs glabrous; lvs. oblong-lanceolate; petioles slender*.....46. **mandshuri-**
BB. *Fls., at least the pistillate, in lateral, long and slender racemes: winter-buds with 2 valvate scales.* **[cum**
C. *Petals present; fls. of both sexes in racemes, sometimes leafy at base, with the lvs.: lvs. 3-foliolate*.....
D. *Petioles and lvs. pubescent beneath: sepals and petals 5*.....47. **Henryi**
DD. *Petioles and lvs. glabrous at maturity: sepals and petals 4*..48. **cissifolium**
CC. *Petals wanting; pistillate fls. in pendulous racemes, staminate corymbose, pendulous, both sexes from lateral leafless buds before the lvs.: lvs. 3–5-foliolate*.....49. **Negundo**

Section CAMPESTRIA.

1. **monspessulànum,** Linn. (*A. trilobàlum,* Lam.). Shrub or small tree, 25 ft.: lvs. 3-lobed, coriaceous, 1–3 in. across, shining above, glaucous and glabrous beneath; lobes entire or with few obtuse teeth: corymbs erect: fr. with slightly spreading wings. S. Eu., N. Afr., W. Asia. Gt. 1893, p. 363. H.W. 3, p. 46. G.W. 8, p. 195 (habit).—Shrub or small tree of slow growth, with a dense, rounded head and, in temperate regions, nearly evergreen foliage, thriving well in dry situations. Var. **ibèricum,** Koch. (*A. ibèricum,* Bieb.). Lvs. larger, the inner lobes usually slightly 3-lobed, obtuse.

2. **campéstre,** Linn. Shrub or tree, occasionally 50 ft., with corky branches: lvs. 3–5-lobed, 1½–3½ in. long, green and pubescent beneath or nearly glabrous; lobes entire or the middle one slightly 3-lobed: corymbs erect, hairy: fr. with horizontally spreading wings. Eu., W. Asia. H.W. 3:46, p. 45. F.E. 20, pl. 108 (habit). Gt. 1893, p. 327.—Shrub or tree of moderate, dense growth, with dull green foliage, valuable for planting as undergrowth and on dry ground. Many varieties and garden forms: Var. **argénteo-variegàtum,** Schwerin. Lvs. with large white blotches. Var. **pulverulèntum,** Kirchn. Lvs. sprinkled with white. Var. **austrìacum,** DC. Usually a tree: lvs. 5-lobed, with acute, nearly entire lobes: fr. glabrous. F.E. 19, pl. 98 (habit). Var. **taùricum,** Kirchn. Shrub: lvs. 5-lobed; small, lobes 3-lobed. Var. **hebecárpum,** DC. Fr. and generally the lvs. pubescent beneath.

3. **Ópalus,** Mill. (*A. ìtalum,* Lauth). Small tree, 30 ft.: lvs. 5-lobed, 3–5 in. long, glaucous beneath and at length glabrous; lobes obtusely dentate, short and broad, the middle ones often 3-lobed: corymbs somewhat drooping: fr. with slightly spreading wings. S. Eu., Orient. W.D.B. 2:171.—A variable species, similar to a small-lvd. sycamore maple. Var. **hyrcànum,** Pax (*A. hyrcànum,* Fisch. & Mey. *A. taùricum,* Hort. *A. trilobàlum,* Hort., not Lam.). Petioles very slender, red, 2–4 in. long; segms. of the lvs. 3-lobed, longer than broad, with straight margins. Gt. 1893, p. 361.

91. Acer Miyabei. (×½)

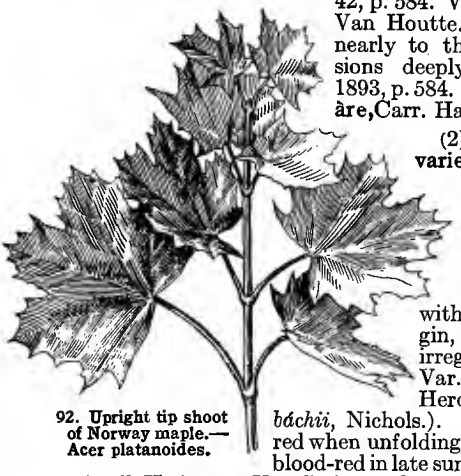
Section PLATANOIDEA.

4. **Miyábei,** Maxim. Fig. 91. Tree, to 40 ft.: branches corky: lvs. 5-lobed, lobes lobulate or coarsely dentate, obtusely acuminate, with obtuse teeth, at first pubescent on both sides, later only beneath, pale green beneath, 5–6 in. long: corymbs long-stalked, 10–15-fld., pubescent: fr. pubescent with horizontally spreading wings. Japan. G.F. 6:143 (adapted in Fig. 91). S.I.F. 2:45.—Handsome, vigorous tree, quite hardy at the Arnold Arboretum.

5. **platanoìdes,** Linn. NORWAY MAPLE. Fig. 92. Large tree, to 100 ft.: lvs. 5-lobed, cordate at base, glabrous, light green and lustrous beneath, lobes pointed, remotely dentate with pointed teeth: corymbs glabrous; fls. yellowish green: fr. glabrous, with horizontally spreading wings. Eu., Caucasus. H.W. 3:45. Pax 49. Gt. 42, p. 561, 584, 585.—Large, handsome tree, with round, spreading head, resembling somewhat *A. saccharum.* The lvs. turn pale yellow in autumn. Many garden forms, some of which are here arranged in two groups, the first being remarkable for the manner in which the lvs. are cut and for the habit; the second being chiefly remarkable for their coloring:

(1) Var. **cucullàtum,** Nichols. Lvs. irregularly and shortly lobed, crimped, light green. Var. **disséctum,**

Jacq. Similar to var. *Lòrbergii*, but with darker foliage and of slower growth. Var. **globòsum**, Nichols. Forming a globose head. M.D.G. 1903:189. G.W. 5, p. 14. Var. **laciniàtum**, Ait. Lvs. irregularly divided, the divisions bending downward: growth upright. Gt. 42, p. 584. Var. **Lorbérgii**, Van Houtte. Lvs. divided nearly to the base, divisions deeply lobed. Gt. 1893, p. 584. Var. **columnàre**, Carr. Habit columnar.



92. Upright tip shoot of Norway maple.—Acer platanoides.

(2) Var. **álbovariegàtum**, Nichols. Lvs. with large white blotches. Var. **aûreomarginâtum**, Pax. Lvs. with yellow margin, somewhat irregularly lobed. Var. **rûbrum**, Herd. (var. *Reitenbáchii*, Nichols.). Lvs. greenish red when unfolding, turning dark blood-red in late summer. Gt. 16: 545. B.H. 18:39. Var. *Genèva*, Ellwanger & Barry, is probably not much different. Var. **Schwédleri**, Koch. Lvs. bright red when young, changing to dark green. G.C. II. 15:565. Var. **Stòllii**, Spaeth. More upright-growing: lvs. usually 3-lobed, with entire lobes, purple when unfolding, later dark green. Gt. 42, p. 585. Var. **Wittmâckii**, Schwerin. Lvs. usually 3-lobed, with an irregularly dentate and undulate yellow margin, reddish brown when unfolding, later bright green with most of the tips transformed into peculiar reddish brown appendages becoming, finally, dark green. Gt. 52:1516. Var. **Drûmmondii**, Drumm. Lvs. green with white margin, red when unfolding. M.D. 1910:1.

6. **truncàtum**, Bunge. Tree, to 25 ft.: lvs. deeply 5-lobed and mostly truncate at the base, 2½–4 in. across, glabrous, light green, purplish when unfolding; lobes acuminate, setosely pointed, entire or sometimes the middle ones 3-lobed: fr. with yellow, short and broad wings, spreading at right or obtuse angles. N. China. S.T.S. 1:76.—Hardy tree, with handsome, dense foliage.

7. **píctum**, Thunb. Tree, 60 ft.: lvs. 5- or 7-lobed, 3–7 in. across, usually pubescent beneath when young; lobes entire, acuminate, sometimes very broad and short: fls. yellow: wings of the fr. upright, brown or brownish yellow, hardly twice as long as the nutlets. Manchuria, Japan. S.I.F. 1:65.—Handsome round-headed tree, with bright green foliage, hardy. Var. **parvifòrum**, Schneid. (*A. píctum* var. *Mòno*, Pax. *A. Mòno*, Maxim.). Wings of the frs. spreading: lvs. more cordate. China. J.H.S. 29:349, 350. The form intro. as *A. tenellum* belongs here; the true *A. tenellum*, Pax, is not in cult.

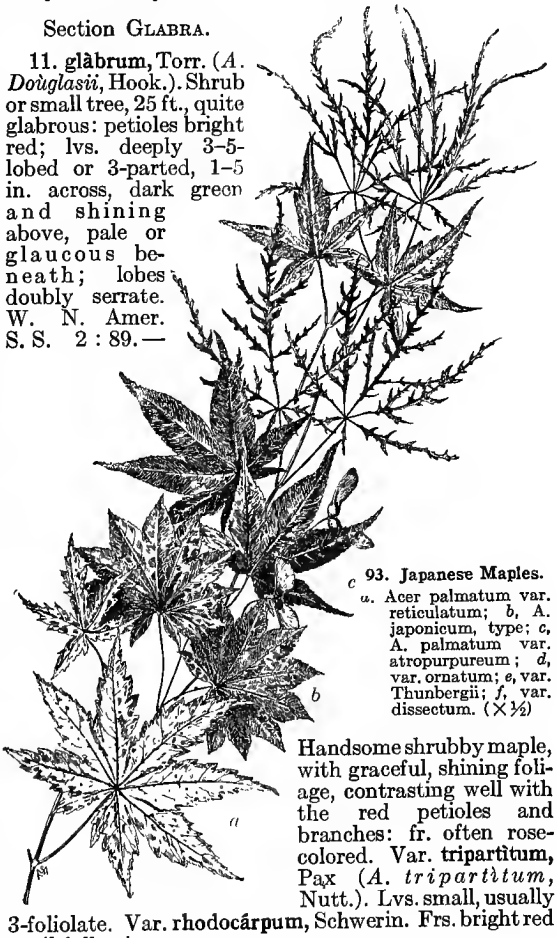
8. **cappadócicum**, Gled. (*A. lætum*, C. A. Mey.). Tree, to 50 ft.: lvs. 5–7-lobed, usually cordate, 3–6 in. across, glabrous, light green and lustrous beneath; lobes entire, acuminate: fls. greenish yellow, in upright peduncled corymbs: fr. with spreading wings, the wings usually 2–3 times as long as the nutlets. From the Caucasus to W. China and the Himalayas.—Resembles *A. platanoides*, but lobes of lvs. entire and branches smooth; not quite hardy N. Var. **sínicum**, Rehd. Smaller in every part: lvs. 2½–4 in. across, usually 5-lobed, subcordate or truncate at the base: wings of fr. about twice as long as nutlet. W. China. J.H.S. 29:358 (as *A. lætum* var. *cultratum*).—Very similar to *A. píctum*, but always easily distinguished by the smooth greenish bark of the younger branches. Var. **tricaudàtum**, Rehd. Similar to the preceding, but lvs. 3-lobed. J.H.S. 29:357, 358. Var. **hortícola**, Rehd. (*A. lætum* var. *rùbrum*, Schwerin; *A. cólchicum* var. *rùbrum*, Hort.). Lvs. blood-red, when unfolding. Var. **trícolor**, Rehd. (*A. lætum* var. *trícolor*, Schwerin). Lvs. blood-red, sprinkled with rosy pink, when young. The last two beautiful forms usually remain shrubby. Var. **aûreum**, Rehd. (*A. lætum aùreum*, Hesse). Lvs. red and golden yellow.

9. **lóngipes**, Rehd. Tree, to 30 ft.: young branches with smooth greenish bark: lvs. 3-, rarely 5-lobed, or occasionally undivided and ovate, 5–7 in. broad, lobes entire, long-acuminate, light green and soft-pubescent beneath, purple when unfolding: corymb large and loose, short-peduncled or nearly sessile, glabrous: fr. with the wings spreading at right angles. W. China.—A very handsome maple, easily distinguished from all allied species by the large, 3-lobed lvs., pubescent beneath.

10. **catalpifòlium**, Rehd. Tree, to 60 ft.: younger branches smooth, greenish: lvs. ovate to ovate-oblong, undivided, entire, sometimes with a broad rounded lobe near the base, 4–8 in. long and 2–5 in. broad, rarely mixed with a few 3–5-lobed lvs., light green and glabrous beneath: corymbs sessile, large and loose, to 8 in. across: wings of the fr. spreading at obtuse angles. W. China.—Very distinct and beautiful tree, but apparently not hardy N.

Section Glabra.

11. **glàbrum**, Torr. (*A. Doùglasii*, Hook.). Shrub or small tree, 25 ft., quite glabrous: petioles bright red; lvs. deeply 3–5-lobed or 3-parted, 1–5 in. across, dark green and shining above, pale or glaucous beneath; lobes doubly serrate. W. N. Amer. S. S. 2:89.—



93. Japanese Maples.
a. Acer palmatum var. reticulatum; *b*, A. japonicum, type; *c*, A. palmatum var. atropurpureum; *d*, var. ornatum; *e*, var. Thunbergii; *f*, var. dissectum. (×½)

Handsome shrubby maple, with graceful, shining foliage, contrasting well with the red petioles and branches: fr. often rose-colored. Var. **tripartìtum**, Pax (*A. tripartìtum*, Nutt.). Lvs. small, usually 3-foliolate. Var. **rhodocárpum**, Schwerin. Frs. bright red until fully ripe.

Section Palmata.

12. **circinàtum**, Pursh. Small tree, rarely 40 ft.: branchlets, petioles and peduncles glabrous: lvs. 7–9-lobed, 2–7 in. across, glabrous; lobes acute, doubly serrate: fls. in drooping corymbs, with purple sepals. W.

N. Amer. S.S. 2:87.—Handsome, round-headed tree or shrub, beautiful with its delicate light green foliage, red fls., rose-colored fr., and its orange and scarlet fall coloring.

13. **palmàtum,** Thunb. (*A. polymórphum,* Sieb. & Zucc.). JAPAN MAPLE. Shrub or small tree, 20 ft.: branchlets, petioles and peduncles glabrous: lvs. 5–9-lobed or divided, 2–4 in. across, glabrous, lobes oblong, acuminate, doubly serrate or incised: corymbs few-fld., glabrous, erect, with small purple fls.: fr. small, glabrous; the wings spreading at an obtuse angle. Japan. S.Z. 1:145, 146. S.I.F. 1:68. F.E. 19, pl. 92 (habit).—A.F.

94. Acer japonicum. (×½)

12:11. J.H.S. 29:340.—This species and *A. japonicum* are known as Japanese maples. They are extremely handsome shrubs of dense though graceful habit, and with elegant foliage, beautiful especially in spring for its delicate shades of green and red, and again in autumn, when the lvs. assume the most striking tints. Some of the more vigorous-growing varieties, like *atropurpureum, dissectum, ornatum,* and the typical forms, are hardy even in New England, while most of the variegated forms are more tender. They grow best in partly shaded situations and in well-drained, rich soil. There are many varieties, mostly intro. from Japanese gardens, of which the following are some of the best. They may be divided into 5 groups, representing various degrees of dissection of the lvs.:

(1) **A. palmàtum** var. **Thúnbergii,** Pax (*A. palmàtum,* Thunb.). Fig. 93, *e*. Lvs. deeply 5–9-lobed or cleft; lobes oblong-lanceolate, coarsely and doubly serrate or incised. Var. **atropurpùreum,** Van Houtte (var. *nìgrum,* Hort.). Fig. 93, *c*. Lvs. dark purple, coarsely doubly serrate. F.S. 12:1273. J.H.S. 29:342. F.E. 14, pl. 42, 32:767 (habit). Var. **sanguíneum,** Carr., is lighter red than var. *atropurpureum.* I.H. 14:526. Var. **bícolor,** Koch (var. *atropurpùreum variegàtum,* Hort.). Lvs. dark purple, with large carmine blotches, the lobes half purple and half carmine. Var. **aûreum,** Nichols. Lvs. yellow. Var. **versícolor,** Schwerin (*A. polymórphum septémlobum versicolòrum,* Van Houtte). Lvs. bright green, with large white spots. F.S. 14:1498. Var. **rôseo-marginàtum,** Schwerin (*A. polymórphum rôseum marginàtum,* Pynaert). Lvs. small, deeply cut, with narrow pink margin. F.S. 15:1566. I.H. 28:430. Var. **crîspum,** André. Lvs. small, with involute margins; of distinctly upright growth. I.H. 17:43.

(2) Var. **septémlobum,** Koch (*A. septémlobum,* Thunb.). Lvs. mostly 7-lobed; lobes broad, equally doubly serrate. Gt. 42, p. 680. J.H.S. 29:345. Var. **rûbrum,** Schwerin. Lvs. large, deep red when young, becoming almost green later. Var. **reticulàtum,** André. Fig. 93, *a*. Lvs. greenish yellow, with green margin and dark green veins. I.H. 17:18. Var. **trícolor,** Nichols. Lvs. with red, pink and white spots.

(3) Var. **linearílobum,** Sieb. & Zucc. (var. *scolopendrifòlium,* Hort., not Schwerin). Lvs. divided nearly to the base; lobes linear, remotely serrate or nearly entire. Gt. 42, p. 681. Var. **atrolineàre,** Schwerin (var. *linearílobum atropùrpureum,* Nichols.; var. *pinnatifòlium atropurpùreum,* Hort.). Lvs. dark red.

(4) Var. **disséctum,** Koch (*A. polymórphum* var. *decompósitum,* Sieb. & Zucc. *A. polymórphum palmatífidum,* Van Houtte). Fig. 93, *f*. Lvs. divided to the base in 5–9 pinnatifid lobes. S.Z. 1:146. F.S. 21:2156. J.H.S. 29:346. M.D.G. 1902:209. F.W. 1875: G.C. III. 31:46 (suppl.). Var. **ornàtum,** Carr. (var. *disséctum atropurpùreum,* Hort.). Fig. 93, *d*. Lvs. deeply cut, deep red. I.H. 17:46. R.H. 1867:391. F.E., pl. 49 (habit). Var. **Frederíci-Guilélmi,** Carr. (var. *pinnatífidum rôseo-pictum,* Lem.). Lvs. finely cut, green, with white and pink spots. I.H. 14:523. R.H. 1867:391.

(5) Var. **sessilifôlium,** Maxim. Lvs. deeply cut, with very short petioles. G.C. II. 16.—Of little decorative value.

14. **Sieboldiànum,** Miq. (*A. japónicum* var. *Sieboldiànum,* Franch. & Sav.). Small tree or shrub: branchlets, petioles and peduncles pubescent when young: lvs. 7–9-lobed, cordate or nearly truncate at the base, 2–3½ in. across, glabrous except on the veins beneath; lobes ovate-oblong, acuminate, sharply serrate: corymbs long-peduncled, nodding; fls. yellowish, small: fr. small, glabrous or slightly pubescent, the wings spreading at an obtuse angle. Japan. S.I.F. 2:45. Var. **microphýllum,** Maxim. Lvs. smaller, 1½–2½ in. across. S.I.F. 2:42.—This species is hardy at the Arnold Arboretum; it is similar to *A. palmatum,* but somewhat coarser.

15. **japônicum,** Thunb. Figs. 93, *b*, and 94. Small tree or shrub: branchlets, petioles and peduncles pubescent when young: lvs. 7–11-lobed, cordate, 3–6 in. across, light green, with silky hairs when unfolding; lobes ovate, doubly serrate: corymbs few-fld., pendulous; fls. large, purple: fr. finally glabrous; wings spreading at an obtuse angle. Japan. S.Z. 1:144. S.I.F. 1:66. Var. **macrophýllum,** Schwerin. Lvs. large, light green. Var. **aûreum,** Schwerin. Lvs. yellow. Var. **Pârsonsii,** Veitch (var. *filicifòlium,* Hort.; var. *laciniàtum,* Hort.). Lvs. large, divided nearly to the base in 9–11 pinnatisect segms. J.H.S. 29:334. R.B. 32:197.

Section SPICATA.

16. **Oliveriànum,** Pax. Tree, to 30 ft.: branchlets glabrous: lvs. 5-lobed, truncate or subcordate at the base, glabrous, finely reticulate and lustrous beneath, 2½–4 in. across; lobes broad, ovate, long-acuminate, finely serrate: panicles nearly corymbose, long-peduncled, glabrous; fls. whitish, small: wings of fr. spreading nearly horizontally; wing with nutlet about 1 in. long. W. China. S.T.S. 1:77.—A graceful maple, resembling *A. palmatum,* but larger. In young plants, the lvs. are often deeply cut with narrow, elongated lobes. J.H.S. 29:356, 359 (as Acer sp.).

17. **tatáricum,** Linn. Shrub or small tree, 20 ft.: lvs. roundish oval or oblong, cordate, sometimes slightly lobed, 2–4 in. long, doubly serrate, nearly glabrous: fls. in long-peduncled panicles, white: wings of fr. nearly upright or slightly spreading, bright red in summer. S.E. Eu., Orient. H.W. 3, p. 43.—Round-headed small tree, growing best in somewhat moist soil.

18. **ginnàla,** Maxim. (*A. tatáricum* var. *ginnàla,* Maxim.). Fig. 95. Shrub or small tree, 20 ft.: lvs. 3-lobed, 1½–3½ in. long, glabrous, the terminal lobe elongated, doubly serrate: fls. in long-peduncled panicles, yellowish, fragrant. Manchuria, N. China, Japan. Gt. 1877:308. S.I.F. 2:44. F.E. 17, pl. 72 (habit). Var. **Semenôwii,** Pax (*A. Semenôwii,* Regel & Herd.). Shrub: lvs. smaller, deeply 3- or nearly 5-lobed. Turkestan.—Graceful shrub, with handsome foliage, turning bright red in autumn; may be used as a substitute for the Japanese maples where these are not hardy.

19. **spicàtum,** Lam. (*A. montànum,* Ait.). MOUNTAIN MAPLE. Shrub or small tree, rarely 30 ft.: lvs. 3-,

or slightly 5-lobed, coarsely serrate, pubescent beneath, 2½–4½ in. long : racemes rather dense, long, upright: fr. with diverging wings, bright red in summer. E.N. Amer. S.S. 2:82, 83. H.T. 328.—Valuable as undergrowth; lvs. turn yellow and scarlet in fall. Var. **lacinià̀tum,** Jouin. Lvs. deeply and irregularly lobed and incised.

20. **caudà̀tum,** Wall. Large tree: lvs. 5-, or sometimes 7-lobed, cordate, 3–5 in. long and about as broad, brownish pubescent on the veins beneath; lobes ovate, long-acuminate, incisely serrate: panicle upright, cylindric, with the peduncle 5–6 in. long: fr. small, in upright panicles; wings spreading at right angles. Himalayas. The type is not in cult., but the two following varieties are: Var. **ukurunduénse,** Rehd. (*A. ukurunduénse,* Fisch. & Mey. *A. spicà̀tum* var. *ukurunduénse,* Maxim.). Small tree: branchlets and petioles pubescent while young: lvs. glabrous above, pubescent beneath, sometimes only along the veins; lobes coarsely serrate: panicle pubescent: wings of the fr. often nearly upright: otherwise like the type. Japan, Manchuria. S.T.S. 1:82. S.I.F. 2:43. G.C. II. 15:172. Var. **multiserrà̀tum,** Rehd. (*A. multiserrà̀tum,* Maxim. *A. erò̀sum,* Pax). Tree, to 30 ft.; very similar to the preceding variety, but glabrous or nearly glabrous. W. China.

21. **macrophýllum,** Pursh. Large-leaved Maple. Tree, to 100 feet high: lvs. cordate, deeply 3–5-lobed or cleft, pubescent when young, pale green beneath, 8–12 in. across; middle lobe mostly 3-lobed: panicles glabrous, narrow, pendulous, 4–5 in. long: fr. with yellow, bristly hairs, wings spreading at right angles or nearly upright, over 1 in. long. W. N. Amer. S.S. 2:86, 87. F.E. 14, pl. 44 (habit). Gn.M. 2:107 (habit). —Handsome round-headed tree, remarkable for its large foliage; not hardy in the N.

22. **pseùdoplátanus,** Linn. Sycamore Maple. Tree, 70 ft. high: lvs. 5-lobed, coarsely crenate-serrate, 3½–7 in. across, deep green above, glaucous and mostly glabrous beneath: racemes pendulous: fr. glabrous. Eu., Caucasus. Gt. 42:260, 261. H.W. 3:44, p. 39. F.S. R. 3, p. 181. F.E. 15, pl. 47 (habit).—Large tree of vigorous growth, with large, spreading head; thrives well even in exposed situations. Many varieties and garden forms: Var. **villò̀sum,** Presl. Lvs. chartaceous, pubescent beneath. Var. **erythrocárpum,** Carr. Fr. bright red: lvs. smaller and more lustrous. R.H. 1864: 171. M.D. 1905:1. Gn. 76, p. 540. Var. **purpuráscens,** Pax (vars. *purpùreum* and *atropurpùreum,* Hort.). Lvs. purplish red beneath; of robust growth. Var. **Handjèryi,** Spaeth (var. *Prinz Handjery,* Hort.). Lvs. purplish beneath, bright red when unfolding. Var. **Wórleei,** Schwerin (var. *lutéscens,* Hort.). Lvs. yellow. Var. **álbo-variegà̀tum,** Kirchn. Lvs. with white blotches and spots, reddish while young. Var. **Leopóldii,** Lem. Similar to the preceding variety; bright rosy pink while young. I.H. 1864:411. R.B. 1906:197. Var. **bícolor,** Spaeth. Lvs. light green while young, with yellow, finally whitish, spots. Var. **trícolor,** Kirchn. Lvs. purplish while young, spotted with yellow. Var. **quadrícolor,** Schwerin (var. *Simonii* Pax, var. *Simon-Louis frères,* Deegen). Lvs. with large, white spots and also sprinkled with small dots; pink while young. Var. **nervò̀sum,** Schwerin. Habit pyramidal, of slow growth: lvs. marked with yellow between the veins above, purplish beneath.

23. **Heldreìchii,** Orph. Tree: lvs. 5-lobed, the middle lobe divided nearly to, the outer half way to the base, 3–5 in. across, glabrous, dark green and shining above, glaucous beneath; lobes coarsely and doubly serrate: panicle erect, long-stalked, ovate. S. E. Eu. Gt. 34:1185. G.C. II. 16:141. Var. **purpurà̀tum,** Schwerin. Lvs. intensely red beneath.

24. **Trautvétteri,** Medw. (*A. velùtinum,* Hort., not Boiss. *A. insígne,* Nichols., not Boiss. & Buhse). Lvs. slightly cordate, deeply 5-lobed, 5–7 in. across, glaucous beneath and pubescent when young; lobes coarsely crenate-serrate, longer than broad: panicle erect, ovate. Caucasus. Gt. 40, pp. 264–266. G.C. II. 16:75. B.M. 6697 (as *A. insigne*).—Similar to *A. insigne,* but hardier, with smaller lvs. and smaller panicle.

25. **insígne,** Boiss. & Buhse (*A. Van Vólxemi,* Mast.). Large tree: lvs. 5-lobed, deeply cordate, 5–10 in. across, bright green above, glaucous and at length glabrous beneath; lobes about as long as broad, coarsely crenate-serrate: panicles large, erect. Caucasus, N. Persia. G.C. II. 7:73; III. 10:9.—Remarkable for its large, handsome foliage; not hardy in the N. Var. **velùtinum,** Boiss. Lvs. densely pubescent beneath. G.C. III. 10:189. Var. **Wólfii,** Schwerin. Lvs. red beneath.

Section Integrifolia.

26. **oblóngum,** Wall. Tree, to 50 ft: lvs. coriaceous, oblong, entire, long but bluntly acuminate, rounded and 3-nerved at the base, glabrous, reticulate and usually glaucous beneath, 2–7 in. long: panicle short, pubescent; fls. small, greenish: wings of fr. at right angles or horizontally spreading. Himalayas, W. and Cent. China. Jacquemont, Voy. Inde 4:34. Var. **côncolor,** Pax. Lvs. green beneath.—Not hardy in the northern states. In young plants, the lvs. are sometimes lobed at the base. J.H.S. 29:95. Recently advertised as *A. discolor;* the true *A. discolor,* Maxim., is not in cult.

Section Indivisa.

27. **carpinifò̀lium,** Sieb. & Zucc. Hornbeam Maple. Tree, 30 ft.: lvs. oblong-ovate, acuminate, sharply and doubly serrate, nearly glabrous, 3–6 in. long: staminate fls. apetalous, in few-fld. racemes; pistillate with petals, in longer racemes. S.Z. 2:142. G.C. II. 15:564. Gt. 41, p. 174. S.I.F. 1:69. J. H.S. 29:75. G. W.3:615.—Very distinct, hardy species; the lvs. are almost exactly like those of Carpinus. This is the only species of this section; the other species included here by Pax have been referred to other sections, mostly to the following (see Sargent, Plantæ Wilsonianæ 1:92).

95. Acer ginnala. (×½)

Section Macrantha.

28. **Dà̀vidii,** Franch. Tree, to 50 ft.: branchlets glabrous: lvs. ovate or oblong-ovate, 2½–8 in. long, acuminate, subcordate or rounded at base, unequally crenate-serrate, green beneath and rufously villous on the veins while young, finally glabrous or nearly so: racemes slender, pendulous, glabrous: wings of fr. spreading horizontally. Cent. China. S.T.S. 1:83. J.H.S. 29:86, 90.—Handsome tree; hardy at the Arnold Arboretum, the lvs. turning bright yellow or purple in autumn. In young plants, the lvs. are often lobed at the base.

29. **laxiflò̀rum,** Pax. Tree, to 50 ft.: lvs. ovate-oblong, with 2 or 4 short lobes near the base, 2½–4 in.

long, long-acuminate, cordate at the base, sharply serrate, green beneath, soon glabrous: racemes slender, pendulous, glabrous; fls. yellowish: wings of fr. spreading at right angles, rarely horizontally. W. China. Pax 35. Var. **longílobum,** Rehd. Lvs. distinctly 5-lobed, upper pair of lobes long-acuminate, floccose-tomentose on the veins beneath while young: fls. purple. W. China.—More graceful than the typical form.

30. **cratægifòlium,** Sieb. & Zucc. Small tree, to 30 ft.: lvs. oblong-ovate, often with 2 or 4 lobes near the base, 2–3 in. long, acuminate, rounded or cordate at the base, unequally serrate, bluish gray beneath: racemes 5–8-fld., glabrous: fr. on pedicels about ¼in. long; wings nearly horizontal. Japan. S.Z. 1:147. S.I.F. 1:67.—Graceful species; hardy at the Arnold Arboretum.

96. Acer saccharinum (or A. dasycarpum).—Silver or soft maple. (×⅛)

31. **Tschonóskii,** Maxim. Small tree, to 15 ft.: lvs. orbicular-ovate in outline, 5-, or rarely 7-lobed, 1¾–4 in. long, light green beneath and rufously pubescent on the veins, finally glabrous or nearly so; lobes ovate, long-acuminate, sharply and doubly serrate, the middle one slightly lobed: racemes slender, few-fld.: fr. on slender, filiform stalks; wings spreading at about right angles. Japan. S.T.S. 1:17. S.I.F. 2:43.—Graceful shrubby tree; hardy at the Arnold Arboretum.

32. **rufinérve,** Sieb. & Zucc. Tree, to 40 ft., with striped bark: branches glaucous when young: lvs. rounded at the base, 3-lobed, 3–5 in. long, doubly serrate, ferrugineously pubescent on the veins beneath when young: racemes ferrugineously pubescent: fr. short-stalked; wings spreading at right angles. Japan. S.Z. 2:148. S.I.F. 1:67. Var. **álbo-limbàtum,** Hook. Lvs. edged with white. B.M. 5793.

33. **pennsylvánicum,** Linn. (*A. striàtum,* Dur.). Striped Maple. Moosewood. Tree, rarely 40 ft.: bark greenish, striped with white lines: lvs. slightly cordate, roundish-obovate, 3-lobed at the apex, 5–7 in. long, finely serrate, ferrugineously pubescent on the whole lower surface when young: racemes glabrous, drooping: fr. short-stalked, in long, drooping racemes; wings spreading at right angles. E. N. Amer. S.S. 2:84, 85. Michx. Hist. Arb. 2:17. Em. 566. H.T. 330.—Handsome medium-sized tree of upright, dense habit, with bright green, large foliage, turning clear yellow in autumn, and attractive even in winter from its smooth, greenish bark, striped with white. Var. **erythrócladum,** Spaeth. Shoots bright red during autumn and winter.

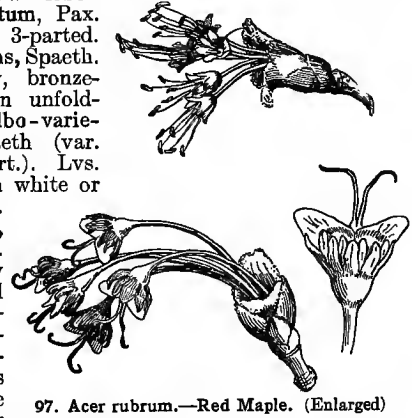
Section Arguta.

34. **tetrámerum,** Pax. Tree, to 25 ft: branchlets glabrous: lvs. ovate to oblong-ovate, 2–3½ in. long, acuminate, truncate or rounded and usually 3-nerved at the base, unequally incisely serrate or sometimes slightly lobed, light green and pubescent beneath, rarely nearly glabrous: staminate fls. in few-fld. sessile racemes from lateral leafless buds; stamens 4 or sometimes 6; disk lobed; pistillate fls. in elongated racemes, usually few-fld.: fr. slender-stalked; nutlet thick, strongly veined. Cent. and W. China. S.T.S. 1:85.—Graceful, hardy tree, very variable. Var. **lobulàtum,** Rehd. Lvs. distinctly lobed, nearly glabrous. J.H.S. 29:352, 355. Var. **betulifòlium,** Rehd. (*A. betulifòlium,* Maxim.) Lvs. not, or very slightly, lobed, rounded or cuneate at the base, glabrous or glabrescent. Var. **elobulàtum,** Rehd. Lvs. not or scarcely lobed, long-acuminate, rounded and 3-nerved at the base, pubescent beneath. Intro. as *A. stachyophyllum,* but the true *A. stachyophyllum* is a Himalayan species, not in cult. Var. **tiliifòlium,** Rehd. Lvs. ovate, cordate at the base, and 5-nerved, pubescent beneath. Var. **longeracemòsum,** Rehd. Lvs. like in var. *elobulatum:* racemes to 6 in. long, slender.

35. **argùtum,** Maxim. Small tree, to 25 ft.: branchlets pubescent: lvs. broadly ovate in outline, 5-, or rarely 7-lobed, 2–3½ in. long, pale green beneath and grayish pubescent chiefly on the veins, finally nearly glabrous; lobes ovate, long-acuminate, sharply serrate: staminate fls. in short racemes from lateral leafless buds; stamens 4; pistillate fls. in slender many-fld. racemes: fr. slender-stalked, in pendulous racemes; wings spreading horizontally. Japan. S.I.F. 1:69. S.T.S. 66.—Graceful shrubby tree; hardy at the Arnold Arboretum.

Section Rubra.

36. **saccharínum,** Linn. (*A. dasycárpum,* Ehrh. *A. eriocárpum,* Michx.). White or Silver Maple. Fig. 96. Large tree, 120 ft.: lvs. deeply 5-lobed to 5-cleft, 4–6 in. long, green above, silvery white beneath; lobes deeply and doubly serrate: fls. greenish yellow, apetalous: fr. pubescent when young. E. N. Amer. S.S. 2:93. G.C. II. 1:37. Em. 556. H.T. 332. F.E. 32:443 (habit); 29:983 (habit).—Ornamental tree, with wide-spreading, slender branches, growing best in rich and moist soil, but succeeds almost anywhere. Lvs. turn clear yellow in fall. Many garden forms: Var. **Wièri,** Schwerin (var. *Wièri laciniàtum,* Hort.). Branches pendulous: lvs. deeply cleft, with dissected lobes.—A graceful variety, remarkable for its drooping branches and finely divided foliage. M.D.G. 1903:628 (habit). Var. **heterophýllum,** Pax (var. *heterophýllum laciniàtum,* Hort.). Upright: lvs. deeply and unequally divided, with narrow lobes. Var. **tripartìtum,** Pax. Upright: lvs. 3-parted. Var. **lutéscens,** Spaeth. Lvs. yellow, bronze-colored when unfolding. Var. **álbo-variegàtum,** Spaeth (var. *Jühlkei,* Hort.). Lvs. spotted with white or rosy pink. Var. **crìspum,** Schwerin. Lvs. deeply cut and crimped.—Linnæus evidently supposed this species to be the sugar maple, and named it accordingly. He did not know the true sugar maple.



97. Acer rubrum.—Red Maple. (Enlarged)

37. **rùbrum,** Linn. Red, Scarlet or Swamp Maple. Fig. 97. Large tree, 120 ft.: lvs. 3–5-lobed, 3–4 in. long, green above, pale or glaucous beneath; lobes unequally and crenately serrate: fls. red or scarlet, rarely yellowish; petals 5: fr. glabrous. E. N. Amer. S.S. 2:94. Em. 557. G.C. II. 1:173. H.T. 334.—Very valuable tree for street and park planting; attractive at every season from its excellent habit, earliness of the scarlet fls., bright red frs. in late spring, and the beautiful foliage, which turns bright scarlet or orange in autumn. Var. **columnàre,** Rehd. Of upright, colum-

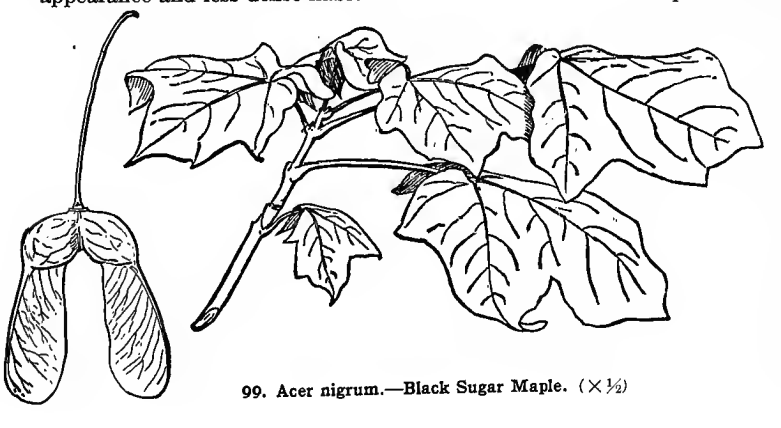
nar habit. Var. **globòsum,** Rehd. Dwarf, compact: lvs. glaucous beneath: fls. bright scarlet. Var. **Drúmmondii,** Sarg. (*A. Drúmmondii*, Hook. & Arn.) Lvs. large, mostly 3-lobed, tomentose beneath: fr. bright scarlet. Southern states. S.S. 2:95. Var. **tomentòsum,** Kirchn. (*A. tomentòsum*, Desf. *A. rùbrum* var. *fúlgens*, Hort.). Of moderate growth: lvs. 5-lobed, pubescent beneath: fls. bright red. Var. **trídens,** Wood (*A. microphýllum*, Pax, *A. semiorbiculàtum*, Pax). Lvs. 3-lobed, rather small, rounded or rarely cuneate at the base, usually pubescent below. On young plants and vigorous shoots, the lvs. are like those of the type. S.S. 13:626. Var. **magnífícum,** Schwerin. Fall-coloring of the lvs. scarlet with green veins. M.D. 1910:1.—The form distributed as var. *Schlesingeri*, Schwerin, does not differ from the type.

Section SACCHARINA.

38. **sáccharum,** Marsh. (*A. sacchárinum*, Wang., not Linn. *A. barbàtum*, Michx.). SUGAR or ROCK MAPLE. Fig. 98. Large tree, 120 ft., with gray bark: lvs. 3–5-lobed, cordate, 3–6 in. long, with narrow and deep sinuses; lobes acuminate, sparingly dentate, usually glaucous and glabrous beneath: corymb hairy: fr. with slightly spreading wings, glabrous. E. N. Amer. S.S. 2:90. Em. 558. H.T. 324. Gn. 65, p. 55 (habit).—An excellent street and shade tree of upright, dense growth, turning bright yellow and scarlet in autumn. It does well in almost every soil. Var. **Rùgelii,** Rehd. (*A. Rugélii*, Pax, *A. sáccharum* var. *barbàtum*, Trel.). Lvs. 3-lobed, generally broader than long, 2–5 in. across, pale green or glaucous beneath, and at length mostly glabrous, coriaceous; lobes nearly entire. Central states. S.S. 2:91 (as var. *nigrum*). Var. **monumentàle,** Schwerin (*A. nìgrum* var. *monumentàle*, Rehd.). Of upright, columnar habit.

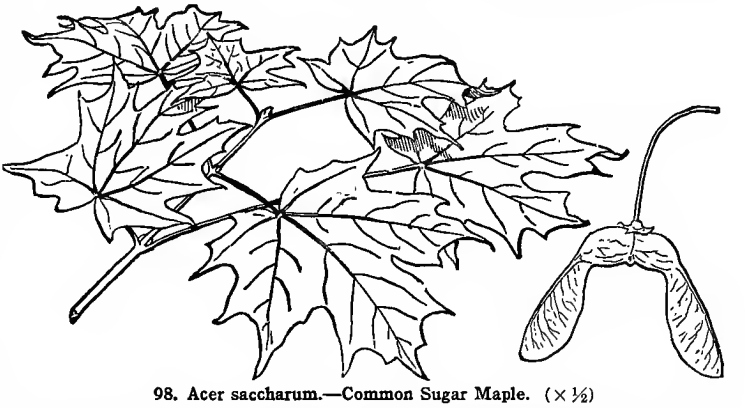
39. **floridànum,** Chapm. (*A. barbàtum* var. *floridànum*, Sarg.). Tree, rarely 50 ft., with pale bark: lvs. mostly truncate at the base, 3-lobed, 1½–3 in. across, glaucous beneath, pubescent; lobes obtuse, entire or slightly 3-lobed: corymb sparingly hairy or nearly glabrous: fr. sparingly villous, finally glabrous. Gulf states. S.S. 2:91. G.F. 4:148.

40. **nìgrum,** Michx. (*A. sacchárinum* var. *nìgrum*, Torr. & Gray. *A. sáccharum* var. *nìgrum*, Brit.). BLACK MAPLE. Fig. 99. Large tree, 120 ft., with black bark: lvs. cordate, with the sinus mostly closed, generally 3-lobed, 5–6 in. across, with broad sinuses, the sides of the blade mostly drooping, green and pubescent beneath; lobes acute, entire or obtusely toothed: fr. with diverging wings. Central states. S.S. 13:625. H.T. 326.—Similar to *A. saccharum*, but of duller appearance and less dense habit



99. Acer nigrum.—Black Sugar Maple. (×½)

41. **leucodérme,** Small (*A. sáccharum* var. *leucodérme*, Sarg.). Tree, to 25, rarely to 40 ft., with light gray or grayish brown bark: lvs. 3–5-lobed, 2–3½ in. across, truncate or slightly cordate at the base, bright yellow-green and soft-pubescent beneath; lobes acuminate, sinuately dentate: corymbs glabrous: fr. villous, finally glabrous; wings wide-spreading. From N. C. to Ga. and La. S.S. 13:624.—Sometimes planted as a street tree in Ga. and Ala.; hardy at the Arnold Arboretum.



98. Acer saccharum.—Common Sugar Maple. (×½)

42. **grandidentàtum,** Nutt. Tree, 40 ft., with dark brown bark: petioles comparatively short: lvs. slightly cordate, 3–5-lobed, with broad sinuses, 2–3 in. across, pubescent beneath, coriaceous; lobes acute or obtuse, entire or slightly 3-lobed: corymbs few-fld., hairy, short-stalked. Rocky Mts. S.S. 2:92.—Hardy at the Arnold Arboretum.

43. **diabólicum,** Koch. Tree, to 30 ft: branchlets pubescent: lvs. 5-lobed, cordate or subcordate, 4–6 in. across, pale green beneath and sparingly pubescent; lobes broadly ovate-acuminate, coarsely and remotely dentate with acute or obtusish teeth: fls. from lateral leafless buds; staminate on long and pendulous, hairy pedicels; sepals wholly or partly connate, petals wanting; pistillate in few-fld. racemes; sepals and petals distinct: pedicels of the fr. ½–2 in. long; nutlets thick, strongly veined, bristly; wings upright or slightly spreading. Japan. G.C. II. 15:532. S.T.S. 1:67. Var. **purpurâscens,** Rehd. (*A. purpurâscens*, Franch. & Sav. *A. púlchrum*, Lavallé). Fls. purple: lvs. turning red in autumn. S.I.F. 1:65.—Hardy at the Arnold Arboretum; similar to *A. pseudoplatanus*, but lvs. larger; the var. *purpurascens* is to be recommended for its early-appearing purple fls.

Section TRIFOLIATA.

44. **nikoénse,** Maxim. Fig. 100. Tree, 40 ft.: branchlets pubescent: lfts. ovate or oblong-elliptic, short-stalked, acute, entire or obtusely dentate, 2–5 in. long, villous-pubescent beneath, petioles hairy, ¾–1½ in. long: corymb few-fld., pubescent: fr. on nodding pedicels ⅓–½in. long; nutlets thick, hairy; wings upright, curved inward. Japan, Cent. China. G.F. 6:155 (adapted in Fig. 100.) Gt. 41, p. 149. S.I.F. 1:68. J.H.S. 29:81. R.H. 1912:126, 127.—Very distinct; lvs. turning brilliant scarlet in autumn.

45. **gríseum,** Pax (*A. nikoénse* var. *gríseum*, Franch.). Tree, to 25 ft., with cinnamon-brown bark separating in thin flakes: branchlets pubescent: lfts. short-stalked, elliptic or ovate-oblong, 1–2 in. long, acute, coarsely toothed with large bluntish teeth, the lateral ones

unequal, deeply dentate on the outer margin, entire or nearly so on the inner, glaucous and pubescent beneath; petioles densely hairy: fls. rather large, in few-fld. hairy corymbs: fr. pendulous on short stalks, with the peduncle scarcely ½in. long; nutlets thick, tomentose; wings spreading at an acute angle. W. China.—J.H.S. 29:98. R.H. 1912:127.—Remarkable for its flaky bark, resembling that of the river birch; hardy at the Arnold Arboretum.

46. **mandshùricum,** Maxim. Shrub or small tree: branchlets glabrous: lfts. oblong or oblong-lanceolate, 2–3½ in. long, short-stalked, acuminate, remotely and obtusely serrate, glabrous, glaucous beneath; petioles glabrous, red, 2–4 in. long: fls. in few-fld. glabrous corymbs: fr. on stalks ½–¾in. long; nutlets thick, glabrous; wings spreading at obtuse angles. Manchuria. —Graceful maple, hardy at the Arnold Arboretum; the red color of the slender lf.-stalks contrasts well with the dark green foliage.

Section NEGUNDO.

47. **Hénryi,** Pax. Tree, to 30 ft.: branchlets slightly pubescent: lfts. 3, elliptic, 2–3½ in. long, stalked, acuminate, entire or coarsely serrate, pale green and pubescent beneath; petioles finely puberulous: fls. nearly sessile, small, greenish in slender pendulous pubescent racemes, lateral, without lvs. or with small lvs. at the base: fr. glabrous, short-pediceled, in pendulous racemes with the stalk 4–7 in. long; wings upright or slightly spreading. Cent. China. J.H.S. 29:93, 96 (as *A. sutchuenense*).—Hardy at the Arnold Arboretum.—It has been concluded that this and the following species which have been hitherto referred to the preceding section are more closely related to *A. Negundo* and therefore better transferred to this section.

48. **cissifòlium,** Koch (*Negúndo cissifòlium,* Sieb. & Zucc. *Crùla cissifòlia,* Nieuwl.). Small tree: lfts. 3, stalked, ovate or elliptic, acuminate, coarsely serrate, sparingly ciliate, 2–3½ in. long, light green beneath and glabrous, or nearly so: racemes slender, many-fld., pubescent; pedicels less than ¼in. long; sepals and petals 4, small: fr. in pendulous racemes; wings slightly spreading. Japan. S.I.F. 2:41.—Handsome, round-headed tree, with slender, spreading branches and graceful bright green foliage, turning orange-yellow and scarlet in autumn; hardy at the Arnold Arboretum.

100 Acer nikoense. (×½)

49. **Negúndo,** Linn. (*Negúndo fraxinifòlium,* Nutt. *N. acerοìdes,* Mœnch. *Rùlac Negúndo,* Hitchc.). ASH-LEAVED MAPLE. BOX ELDER. Fig. 101. Large tree, 70 ft.: lvs. pinnate; lfts. 3–5, ovate or oblong-lanceolate, coarsely serrate or 3-lobed, mostly glabrous, 2–5 in. long: fls. before the lvs.; staminate fls. in pendulous corymbs, pistillate fls. in pendulous racemes. E. N. Amer. S.S. 2:96. Michx. Hist. Arb. 2:18. H.T. 336.—Large, rapid-growing tree of spreading habit, thriving best in moist and rich soil. Much prized in the W., where it withstands cold and dryness. Largely used for shelter-belts and for planting timber-claims. Var. **californicum,** Sarg. (*A. californicum,* Dietr. *Negúndo californicum,* Torr. & Gray). Branches pubescent when young: lfts. 3, of firmer texture, densely pubescent beneath: fr. not constricted at the base. W. N. Amer. S.S. 2:97. Nutt. N. Amer. Sylv. 2:72. Var. **pseùdo-californicum,** Schwerin (*A. californicum,* Hort. *A. Negúndo* var. *californicum,* Kirchn.). Branches green, bloomy; of vigorous growth. Var. **violàceum,** Kirchn. (*A. californicum,* Hort.). A vigorously growing form: branches purplish with glaucous bloom or finely pubescent when young. Var. **argênteo-variegàtum,** Bonamy. Lvs. with broad white margin. Probably the most effective of all variegated hardy trees. F.S. 17:1781. Gn. 68, p. 402 (habit). G. 2:37; 11:97 (habit). Var. **aùreo-variegàtum,** Booth (var. *aùreo-maculàtum,* Schwerin). Lvs. spotted with yellow. Var. **aùreo-marginàtum,** Dieck. Lvs. with yellow margin. Var. **auràtum,** Spaeth (var. *californicum aùreum,* Hort.). Lvs. yellow. R.B. 1906:197. Var. **crìspum,** G. Don. Lfts. curled. These horticultural varieties may be grafted on common box elder seedlings. Box elder also grows from hardwood cuttings, like the grape. Two new forms have been recently described as new species by Britton: *A. intèrior,* distributed from Alberta and Mont. to Ariz. and New Mex. (B.T. 655), and *A. Kingii* (B.T. 656), from Utah; they are closely allied to var. *californicum,* but differ in their glabrous foliage; in the first the wings of the samara are adnate to the nutlet only to or above the middle; in the second the wings reach the point of union of the nutlets.

101. Raceme of young fruit of box elder.—Acer Negundo. (Nat. size)

A. acuminàtum, Wall. (A. caudatum, Brandis, not Wall. A. sterculiaceum, Koch, not Wall.). Allied to A. argutum. Tree: lvs. 3-lobed, 3–4½ in. long, glabrous and light green beneath; lobes long-acuminate, and doubly serrate: wings of fr. spreading at a right angle. Himalayas. G.C. II. 15:364 (as A. caudatum). Tender at the Arnold Arboretum.—*A. ambíguum,* Dippel. Allied to A. pictum. Lvs. pilose beneath: fls. and fr. unknown. Doubtful species of unknown origin.—*A. ámplum,* Rehd. Allied to A. longipes. Tree, to 35 ft.: lvs. 5-lobed, 4–7 in. broad, glabrous: corymb nearly sessile, 5–6 in. across. Cent. China.—*A. barbinérve,* Maxim. Allied to A. argutum. Shrubby tree: lvs. 5-lobed, coarsely serrate: pistillate racemes usually 7-fld.: fr. larger. Manchuria. S.T.S.

1:86.—*A. Bóscii*, Spach. Probably hybrid. A. monspessulanum × tataricum.—*A. brevilabum*, Hesse=A. parviflorum.—*A. cæsium*, Wall. Allied to A. insigne. Tree: lvs. 5-lobed, glabrous, whitish beneath, 6–8 in. across; lobes acuminate, obtusely crenulate-serrate. Himalayas. Not hardy N.—*A. capillipes*, Maxim. Allied to A. rufinerve. Tree, to 30 ft.: lva. 3-lobed, glabrous beneath, red when unfolding, 3½–5 in. long: fls. on slender stalks about ½in. long. Japan. S.T.S. 1:16. Not perfectly hardy at the Arnold Arboretum.—*A. caudátum*, Brandis=A. acuminatum.—*A. cinerascens*, Boiss. Shrub or small tree: lvs. 3-lobed, ½–2 in. long. Similar to A. monspessulanum. Persia.—*A. coriáceum*, Tsch. (A. creticum, Tratt. A. polymorphum, Spach). Probably A. creticum × pseudoplatanus.—*A. crássipes*, Pax. Supposed to be a hybrid between A. obtusatum and A. pennsylvanicum.—*A. crassipes*, Hesse=A. parviflorum.—*A. créticum*, Linn.=A. orientale.—*A. créticum*, Tratt.=A. coriaceum.—*A. Dieckii*, Pax (A. platanoides var. integrilobum, Zabel). Similar to A. platanoides, but lobes entire; probably A. Lobelii × platanoides.—*A. distýlum*, Sieb. & Zucc. Allied to A. oblongum. Tree: lvs. ovate, 5–7 in. long, cordate, crenately serrate, light green and lustrous beneath. Japan, G.C. II. 15:499. S.I.F. 2:41. J.H.S. 29:76.—*A. Duréttii*, Pax. Probably A. monspessulanum × pseudoplatanus.—*A. eriánthum*, Schwerin. Allied to A. caudatum. Small tree: lvs. 5-lobed, 2–3½ in. long, lobes broad, unequally and simply serrate, nearly glabrous beneath: fls. with densely villous disk. W. China. S.T.S. 1:80.—*A. Fárgesi*, Franch. (A. lævigatum var. Fargesii, Veitch). Allied to A. oblongum. Tree, to 30 ft.: lvs. coriaceous, lanceolate-oblong, 2–3½ in. long, narrowed at the base, penninerved, glabrous, light green beneath, not reticulate. W. China. J.H.S. 29:91.—*A. flabellátum*, Rehd. Allied to A. Oliverianum. Tree, to 30 ft.: lvs. 7-lobed, deeply cordate, 3–5 in. across, light green beneath and villous along the veins. Cent. China. S.T.S. 1:81.—*A. Franchétii*, Pax. Tree, to 15 ft.: lvs. 3-lobed; slightly pubescent beneath or glabrous at maturity and light green, 3–4 in. long; lobes broadly ovate, acute, remotely toothed: fls. in short pubescent racemes from lateral leafless buds, with the lvs.: fr. with the wings spreading at right angles or less, nutlets thick, hairy: winter-buds with numerous imbricate scales. Cent. China. S.T.S. 1:87. Belongs to the section Lithocarpa.—*A. fulvéscens*, Rehd. Allied to A. pictum. Tree, to 60 ft.: lvs. usually 3-lobed, 2–4 in. across, beneath covered with a yellowish or fulvous pubescence. W. China. Hardy at the Arnold Arboretum.—*A. heterophýllum*, Willd.=A. orientale.—*A. Hookeri*, Miq. Allied to A. Davidii. Tree, 60 ft.: lvs. cordate-oblong, serrate, 4–6 in. long, quite glabrous beneath. Himalayas.—*A. hýbridum*, Spach. Probably A. italum × pseudoplatanus.—*A. hýbridum*, Baudr.=A. Boscii.—*A. lævigátum*, Wall. Allied to A. oblongum. Small tree: lvs. oblong, nearly entire, attenuate at the base, penninerved, green beneath. Himalayas, China.—*A. lævigátum*, Hort. =A. acuminatum.—*A. Lobélii*, Ten. Allied to A. cappadocicum. Branches glaucous: lvs. rounded at the base; lobes mostly undulated, abruptly pointed. Italy.—*A. Maximowiczii*, Pax (A. urophyllum, Maxim.). Allied to A. Tschonoskii. Small tree: lvs. 3–5-lobed, doubly serrate, the middle lobe much elongated, long-acuminate, glaucescent beneath, glabrous, 2–3 in. long: fr. slender-stalked; wings spreading at an obtuse angle. Cent. China. S.T.S. 1:84.—*A. Máyrii*, Schwerin. Allied to A. cappadocicum and A. amplum. Tree with smooth bark: lvs. usually 3-lobed, glabrous, 3 in. across; lobes very broad, long-acuminate: wings of fr. upright, incurved. Japan.—*A. mexicánum*, Pax (Negundo mexicanum, DC. A. serratum, Pax). Allied to A. Negundo. Lfts. 3, pubescent beneath, densely serrate: fr. glabrous; wings spreading at an acute angle. Mex.—*A. micránthum*, Sieb. & Zucc. Allied to A. Tschonoskii. Shrub or small tree: lva. 5–7-lobed; lobes incised and doubly serrate, glabrous: fls. and fr. small. S.Z. 1:141. S.I.F. 2:44.—*A. neapolitánum*, Ten.=A. obtusatum.—*A. negléctum*, Lange (A. zœschense, Pax). Probably A. campestre × Lobelii. Var. Annæ, Schwerin. Young lvs. deep red, later olive-green. M.D. 1908:1.—*A. obtusátum*, Waldst. & Kit. (A. neapolitanum, Ten.). Allied to A. Opalus. Small tree or shrub: lvs. 5-lobed, pubescent beneath, about 4 in. across; lobes broad, often rounded, obtusely denticulate: wings of fr. spreading at a right angle or less. S. Eu., N. Afr. H.W. 3, p. 47. Tender at the Arnold Arboretum.—*A. orientále*, Linn. (A. creticum, Linn. A. sempervirens, Linn. A. heterophyllum, Willd.). Allied to A. monspessulanum. Shrub, 4 ft.: lvs. nearly evergreen, short-stalked, orbicular or oval, entire or 3-lobed, ½–1½ in. long, glabrous. Orient.—*A. parviflórum*, Franch. & Sav. (A. crassipes, Hesse, not Pax. A. brevilobum, Hesse). Allied to A. caudatum. Tree: lvs. 3–5-lobed, pubescent beneath, 4–6 in. across; lobes broadly ovate, acute, doubly serrate: wings of fr. spreading at an obtuse angle. Japan. S.I.F. 2:42. Not quite hardy at the Arnold Arboretum.—*A. pectinátum*, Wall. Allied to A. pennsylvanicum. Tree: lvs. 3-lobed, setoaely serrulate, 2½–3½ in. across, the middle lobe elongated, acuminate. Himalayas. G.C. II. 15:365.—*A. Pernai*, Schwerin. Supposed hybrid of A. Opalus × monspessulanum. Originated at Vallombrosa near Florence.—*A. robústum*, Pax. Allied to A. palmatum. Small tree: lvs. 7–9-lobed, cordate, 3–4 in. across, glabrous beneath except the tufts of hairs in the axils of the veins; lobea ovate, acuminate, aharply serrate: wings of fr. nearly horizontally spreading. Cent. China.—*A. rotundílobum*, Schwerin (A. barbatum, Booth, not Michx.). Possibly A. obtusatum × monspessulanum.—*A. Schwérinii*, Pax. Affinity doubtful. Lvs. coriaceous, ovate-oblong, cordate, undivided or 3-lobed, glaucous beneath, soon glabrous, 5–7 in. long: fls. and fr. unknown. Probably from the Himalayas. Var. *marmorátum*, Schwerin, has the lva. variegated with light green. Var. *monophýllum*, Schwerin, has the lva. 2–3½ in. long.—*A. sempérvirens*, Linn.=A. orientale.—*A. serrátum*, Pax=A. mexicanum.—*A. sikkiménse*, Miq. Allied to A. Davidii. Tree: lvs. cordate-ovate, coriaceous, long-acuminate, quite glabrous, entire or serrulate, 4–7 in. long: wings of fr. spreading at a right angle. Himalayas.—*A. sinénse*, Pax. Allied to A. Oliverianum. Tree: lvs. 5-lobed, cordate or sometimes truncate, glaucescent beneath, glabrous, 3–6 in. long; lobes ovate, acuminate, sparingly appressed-serrate: panicle elongated: winga of fr. spreading horizontally. Cent. China. S.T.S. 1:78. J.H.S. 29:92.—*A. sterculiàceum*, Wall. (A. villosum, Wall.) Allied to A. Franchetii. Tall tree: lvs. 3–5-lobed, cordate, 6–8 in. across, tomentose below, coarsely serrate: racemes from lateral leafless buds: fr. in long pendulous racemes, often branched at the base; wings of fr. nearly upright. Himalayas.—*A. sutchuenénse*, Franch. (A. sutchuense, Pax). Allied to A. mandshuricum. Small tree: lfts. 3, oblong-lanceolate, unequally serrate, glaucous beneath, 1¾–3 in. loog: corymb many-fld., rather dense. Cent. China. S.T.S. 2:112.—Probably not in cult.; the plant figured by Veitch under this name is A. Henryi.—*A. tegmentòsum*, Maxim. Allied to A. pennsylvanicum. Lvs. 3–4 in. long, glabrous beneath; lobes short: fls. small. Manchuria. G.C. II. 15:75.—*A. trífidum*, Hook. & Arn. Allied to A. tataricum. Small tree: lvs. coriaceous, cuneate-obovate, 3-lobed, glaucous beneath, glabrous, 2–3 in. long; lobea entire. China, Japan. S.Z.2:143.—*A. urophýllum*, Maxim.=A. Maximowiczii.—*A. Vèitchii*, Schwerin. Possibly A. cratægifolium × rufinerve.—*A. villósum*, Wall.=A. sterculiaceum.—*A. Wilsonii*, Rehd. Allied to A. Oliverianum. Tree: lvs. 3-lobed, light green beneath, glabrous, 3½–4 in. across; lobes ovate to oblong-ovate, acuminate, entire, or sparingly serrate: panicle elongated: wings of the fr. spreading at a right angle. Cent. China. S.T.S. 1:79.—*A. zæschénse*, Pax=A. neglectum.

ALFRED REHDER.

ACERÁNTHUS (*Acer*, maple, and *anthos*, flower, in allusion to the maple-like flowers). *Berberidàceæ*. BARRENWORT. A genus of 4–6 species of slender, hardy, herbaceous perennials from Temp. Asia and Algeria, related to the native twin-leaf, Diphylleia. Fls. variously colored, racemose; sepals 7–8, petaloid, the

I02. Achillea Millefolium var. rubrum. (×⅙)

outer ones smaller than the inner; petals flat: lvs. solitary.—Not commonly cult. and the following seen only in botanic gardens.

A. diphýllus, Morr. & Decne. (Epimedium diphyllum, Lodd.). Plant rhizomatous: lfts. obliquely cordate, green above, glaucous beneath: fls. small, bluish white. Japan. B.M. 3448. L.B.C. 19:1858.

N. TAYLOR.

ACHÀNIA: *Malvaviscus*.

ACHILLÈA (its virtues said to have been discovered by Achilles). *Compósitæ*. Includes *Ptarmica*. About 100 species, some of which are hardy herbaceous border and alpine perennials of easy culture.

Leaves simple or compound, often ternate: fl.-heads small, corymbose or racemose; receptacle nearly flat

or convex, chaffy; ray fls. pistillate, fertile, the rays white or pink; disk fls. perfect, fertile.

Most of the achilleas can be grown in ordinary garden soil, preferring open sunlight and well-drained situations. Some are alpine or sub-alpine and require rock-garden conditions. These are indicated under the individual species. Dwarf kinds make carpets in dry, sunny places; large kinds suitable for wild gardens.

Propagation in spring by division, cuttings and seeds; chiefly by the first method and easily accomplished.

103. Achillea filipendulina. (Plant × 1/6)

A. *Rays about 5, except in double forms, half as long as the ovate-oblong involucre; fls. white, red, or yellow.*

B. *Fls. white or red.*

Millefòlium, Linn. MILFOIL. YARROW. Height 1–3 ft.: lvs. bipinnately parted, segms. linear, 3–5 cleft: fls. in flat corymbs. June–Oct. Eu., Asia, Amer. Common in pastures.—Less commonly cult. than vars. **rùbrum** (Fig. 102) and **ròseum,** with red or purple fls.

BB. *Fls. yellow.*

Tournefórtii, DC. (*A. ægyptìaca,* Linn.). Height 12–18 in.: lvs. pinnatisect; segms. roundish, coarsely toothed: fls. pale yellow. June–Oct. Greece.

filipendulìna, Lam. (*A. Eupatòrium,* Bieb.). Fig. 103. Height 4–5 ft.: st. erect, furrowed, glandular spotted and almost hairy: fls. yellow in dense, convex compound corymbs, often 5 in. across. June–Sept. Orient.—Needs staking.

holoserícea, Sibth. & Sm. Similar to preceding, but not glandular spotted: fls. as in *A. filipendulina,* but corymbs simple, terminal, and the petals scarcely as long as the bracts of the involucre. Mts. of Greece. Summer.—More suitable to semi-alpine situations than *A. filipendulina.*

tomentôsa, Linn. A woolly, carpet-like plant for rockeries. Height 8–10 in. Eu., Orient, N. Amer. B.M. 498. Gn. 52, p. 421.

AA. *Rays 6–20, as long as or longer than the rotund or campanulate involucre; fls. white.*

B. *Lvs. not divided.*

Ptârmica, Linn. (*A. macrocéphala,* Pill. & Mitterb.). SNEEZEWORT. Height 1–2 ft.: lvs. serrate: fls. in loose corymbs; all summer. North temperate regions.—Its full-double var. The Pearl (Fig. 104) is much used for cut-flowers and in cemeteries, and is one of the most popular of all hardy herbaceous plants. There are many other varieties.

lingulàta, Waldst. (*A. buglòssis,* Hort.). A stiff, simple-stemmed. perennial, simulating *A. Ptarmica,* but hairy: lvs. broadly spatulate, the petiole long-attenuate and dotted: heads corymbose, the fls. numerous; petals 3–4 times as long as the involucre. Sub-alpine. Hungary and southward. Summer.

sibírica, Ledeb. (*A. mongòlica,* Fisch. *A. Ptarmicòides,* Maxim.). Denser than the last, more erect and rigid: height 1½–2 ft.: fls. larger and in more compact corymbs. July–Sept.

grandiflòra, Bieb. A smooth and erect perennial: lvs. narrowly linear, narrower than in any of the Ptarmica group, distinctly serrulate: corymbs simple or sometimes loosely branched, the peduncles 4–5 times longer than the head; fls. white, large and more showy than most of the genus, longer than the bracts of the involucre. Sub-alpine and scarcely good for ordinary garden conditions. Caucasus. June, July.

BB. *Lvs. deeply divided.*

macrophýlla, Linn. Height 3 ft.: lvs. long, broad. July. Alps. Gn. 52, p. 421.—Better suited to shrubbery than to herbaceous border.

Clavênæ, Linn. (commonly spelled *A. Clavénnæ. A. argéntea,* Hort., not Lam.). Dwarf, tufted, hoary alpine plant; height 10 in.: lvs. dentate at apex; segms. obtuse: fls. spring and summer. Eu. B.M. 1287. Gn. 52, p. 421.—Thrives in sand.

A. Ageràtum, Linn. Fls. yellow. Eu.—*A. ageratifòlia,* Benth. & Hook. (Anthemis Aizoon). Tufted, woolly, silvery gray: fls. white. May, June. Alps.—*A. asplenifòlia,* Vent. Lvs. pinnate, smooth: fls. white. There is a red-fld. form. N. Amer.—*A. atràta,* Linn. Dwarf, tufted, aromatic: radical lvs. petiolate; cauline lvs. pinnatisect: fls. white. Alps.—*A. aùrea,* Lam. Fls. golden yellow, the seeds stipitate: lvs. woolly. Aug., Sept. S. Eu. = Chrysanthemum achilleæfolium (which see).—*A. decolòrans,* Schrad. Lvs. undivided: fls. pale yellow. July. Eu.—*A. Herbaròta,* All. Dwarf, tufted, aromatic alpine: lvs. undivided, serrate: fls. white. May, June.—*A. lìgùstica,* All. Lvs. pinnatifid: fls. white. Eu., Orient.—*A. moschàta,* Jacq. Lvs. smooth, pinnately parted, lobes uncut: fls. white. Eu.—*A. nàna,* Linn. Dwarf, hairy, woolly, aromatic: lvs. pinnatisect: fls. white. Spring. Eu. Used in making Chartreuse.—*A. odoràta,* Linn. Lvs. pinnatisect; lobes cut: fls. white.—*A. pectinàta,* Willd. Fls. pale yellow.—*A. rupéstris,* Huter. Lvs. ½in. long, linear-spatulate, entire. S. Italy. B.M. 6905.—*A. santolinoides,* Lag. 1 ft.: lvs. pinnatisect, hairy-woolly: fls. white. July. Spain.—*A. serràta,* Retz. Lvs. pinnatifid, woolly: fls. white. Siberia(?).—*A. Siehàna,* Hort. Fls. golden yellow, fragrant. Asia Minor.—*A. umbellàta,* Sibth. Very woolly rock plant, 4–5 in.: lvs. pinnatifid; lobes oblong, bluntish, entire or serrate: fls. white. June. Greece.—*A. valesìaca,* Stein. Lvs. pinnately parted: fls. white. June–Aug. Eu. Other trade names are *A. corymbòsa, A. transylvànica* and *A. Hùteri*; none is known in hort. or botanical literature.

N. TAYLOR.†

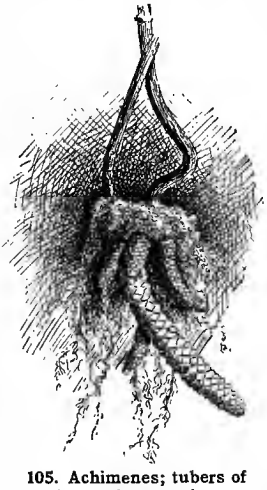
ACHÍMENES (Greek, *cheimaino,* to suffer from cold). Including *Scheèria. Gesneràceæ.* Greenhouse herbs, allied to gloxinias, native to tropical America, grown for bloom in late spring and in summer.

Plant upright, erect, or drooping: lvs. opposite or whorled, serrate or toothed, mostly hairy: underground sts. scaly and catkin-like, and similar growths sometimes in the axils of the lvs: fls. axillary; 5 calyx-lobes narrow and short; corolla-tube cylindrical and limb spreading; anthers 4, connivent in the tube, and a rudiment of a fifth stamen; style long, usually exserted, the stigma dilated or obscurely 2-lobed. —Perhaps 40 species.

104. Achillea Ptarmica var. The Pearl.

The garden achimenes are much confused by hybridization, and it is doubtful whether any of the pure species are in general cultivation in this country. Years ago, the small red-flowered types (of the coccinea section) were frequent, but modern evolution has proceeded from the broad-flowered purple species. The species

described further on seem to have contributed most largely to the present garden forms. Some of the best species are *A. longiflora*, purplish blue; *A. longiflora* var. *alba maxima*, the best white kind; *A. patens* var. *major*, a large flower of purplish rose; *A. pedunculata*, orange; *A. heterophylla*, tubular, a fiery orange at one end and blazing yellow at the other. There are many named varieties, some of the names being Latin in form. In the grandiflora group the tubers or bulbs are clustered; in the longiflora group the tubers are pear-shaped bodies, growing on the ends of root-like rhizomes. The coccinea (Fig. 105) and hirsuta groups are late bloomers.



105. Achimenes; tubers of the coccinea section.

The rhizomes of achimenes should be removed from their winter quarters and spread out thinly in boxes, using a size some 3 inches deep, and a light open mixture of leaf-mold and sand to start them in. The lower inch in the box should be covered with some material that will act as drainage; then cover with an inch or so of the compost, and spread out the rhizomes on this and cover with half an inch of the mixture which has been passed through a half-inch mesh sieve. Place in a moist house in a temperature of 60° to 65° F. and water sparingly until the young growths appear. When these are some 2 inches high, they should be lifted from the boxes with the material that is attached to the roots and potted up into 5- or 6-inch pots or 8-inch pans, spacing them equally, and using some ten to fifteen growths for each pot or pan. The material used for this potting should be rich in humus and of a very open porous nature, so as to provide free access of air to the roots and at the same time allow any excess of water to pass away freely. A useful mixture for this purpose is equal parts of loam, leaf-mold and sand. About one-third the depth of the pots or pans should be occupied with drainage. All the rhizomatous forms of achimenes are shallow-rooting, so that there is no advantage in using large and deep pots. This method of starting the rhizomes first and then potting those that have been started together, is much to be preferred to potting them up directly into the flowering sizes, which method, however, is practised by many cultivators. The advantage of the method advised is that all the pots are filled regularly with growths of equal size and vigor, whereas in the other and older method the rhizomes often start irregularly and the pots are only partially filled with growths. After potting up, the pots should be replaced again in the same house as the rhizomes were started in, and kept shaded from all hot sun. From this period onward, growth is rapid and care must be taken not to allow any of them to suffer for want of moisture at the roots, or failure will ensue. When the plants are 6 or 8 inches high, feeding with weak liquid manure should begin, and should be continued regularly until the plants show signs of exhaustion after flowering. When the flowers appear, the plants should then be removed to a somewhat drier airy greenhouse, kept at a temperature of about 50° F., where they will remain until the flowering season is over. They may then be removed to a greenhouse or coolframe to ripen up. The water-supply should be gradually reduced until the plants die down. The best method of storing the rhizomes is to shake entirely out of the old soil, mix them up in a box of sand, and keep them entirely dry in a shed which does not fall below a temperature of 45° F. until the time comes round for starting them again in March or April.—Propagation is readily effected by means of the rhizomes. Each of these may be used for forming one or many plants. Some of the kinds form numerous scaly buds or short rhizomes in the axils of the upper leaves; these may be saved and treated in exactly the same way as the underground rhizomes for propagation. Cuttings of any of the sorts root readily in a moist warmhouse in summer-time. Every node may be used for stock and the parts may be inserted without removing the leaves.—All members of the genus, including the numerous garden forms, are of the easiest possible culture, and there are few greenhouse plants that will furnish such a display of flowers at such a little cost in time and attention. Some of the forms of weak habit make charming subjects for growing as basket plants. (C. P. Raffill.)

A. *Fls. colored, the tube usually not more than twice the length of the limb.*

B. *Blossoms small, red, scarlet, or orange the limb narrow and sometimes not much spreading.*

ocellàta, Hook. Rhizomes small and tuberous: st. 1–2 ft.: lvs. rich green above and purple beneath, ovate, strongly serrate, with conspicuous purplish petioles: fls. small, 1 in. long, broad-tubed, spotted with black and yellow, the lobes short and obtuse and well separated, drooping on reddish peduncles. Panama. B.M. 4359.—Fine for foliage.

coccínea, Pers. Fig. 105. Height 1–2 ft.: st. reddish: lvs. 3-whorled or opposite, green, ovate-acuminate, serrate: fls. small, scarlet, the corolla twice longer than the erect lanceolate parted calyx on short peduncles. Minute lvs. often borne in the axils. Blooms late. Jamaica.—One of the older types.

heterophýlla, DC. (*A. ignéscens,* Lem. *A. Ghiès-brechtii,* Hort.). Root fibrous: st. 1 ft. or less, dark purple, somewhat hairy: lvs. ovate-acuminate, stalked, serrate, the 2 of each pair usually unequal in size: fls. solitary, on peduncles somewhat longer than the lf.-stalks, long-tubular and slightly curved, with a narrow, nearly equal flaring limb, rich scarlet, yellow within. Mex. B. M. 4871.—This species has tubers like those of the grandiflora section.

106. Achimenes longiflora. (×½)

pedunculàta, Benth. Rhizomes scaly: st. 1½–2 ft., hairy, reddish, tuber-bearing: lvs. opposite, small, ovate, sharply serrate, green, hairy, on short reddish stalks: fls. medium size, drooping and dilated upwards, yellow-red with dark markings and a yellow throat, the limb comparatively short; on long (4–5 in.) bracted sts. Guatemala. B.M. 4077.

BB. *Blossom large, with wide-flaring limb, mostly violet in main color.*

longiflòra, DC. (*A. Jauregùia,* Warscz.). Fig. 106. Rhizomes root-like and filiform, producing pear-shaped tubers at their ends: st. 1–2 ft., hairy: lvs. opposite or 3–4-whorled, ovate-oblong, serrate, hairy, paler and

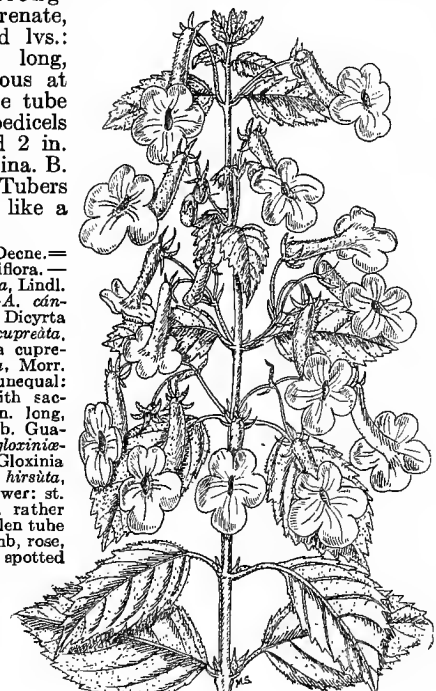
sometimes tinted beneath: fls. solitary, the corolla salver-shaped, with a long and graceful tube; the limb very large and widely spreading, violet-blue and whitish beneath, the lowest segm. sometimes divided. Guatemala. B.M. 3980. P.M. 9:151.—A popular blue type. Var. *álba máxima*, Hort. Fls. large, white.

grandiflòra, DC. Fig. 107. Lvs. mostly larger than in last, rusty below: fls. often more than one from an axil, very large, distinctly red-tinged. Mex. B.M. 4012.—A popular red or wine-colored type.

pàtens, Benth. Height 1–1½ ft.: lvs. unequal, ovate-acuminate, hispid and serrate: fls. violet-blue, with downy calyx, tube shorter than spreading crenate limb. Var. *màjor*, Hort. Large-fld. Mex.

AA. *Fls. pure white, the tube 3–4 times the length of the limb.*

tubiflòra, Nichols., Suppl. p. 483 (*Gloxínia tubiflòra*, Hook. *Dolichodèira tubiflòra*, Hanst.). St. short, with opposite oblong-acuminate, crenate, short-petioled lvs.: fls. 4 in. long, curved, gibbous at the base, the tube downy, the pedicels opposite and 2 in. long. Argentina. B. M. 3971.—Tubers solid, much like a potato.



107. Achimenes grandiflora. (×¼)

A. amábilis, Decne.=Nægelia multiflora.—*A. atrosanguínea*, Lindl.=A. foliosa.—*A. cándida*, Lindl.=Dicyrta candida.—*A. cuprèata*, Hook.=Episcea cuprea-ta.—*A. foliòsa*, Morr. Lvs. cordate, unequal: fls. crimson, with saccate tube 1 in. long, with narrow limb. Guatemala.—*A. gloxiniæflòra*, Forkel.=Gloxinia glabrata.—*A. hirsùta*, DC. Loose grower: st. bulbiferous: fls. rather large, with swollen tube and oblique limb, rose, with yellow and spotted throat. Guatemala. B.M. 4144. P.M. 12: 7. Once popular.—*A. Kleèi*, Paxt. Dwarf: fls. pink-purple. P.M. 16: 289. Form of A. longiflora.—*A. lanàta*, Hanst. (Scheeria lanata, Hanst.). Woolly or white-hairy: fl. pinkish or lilac, large and showy. Mex. B.M. 4963 (alt. to 4954).—*A. multiflòra*, Gardn. Hairy: lvs. broad-ovate: fls. blue, fringed. Brazil. B.M. 3993.—*A. pícta*, Benth.=Tydæa picta.—*A. ròsea*, Lindl. Fls. pink or rose, the peduncles many-fld. Guatamala.—*A. Scheèrii*, Hemsl. (Scheeria mexicana, Seem.). Erect, with purple or blue, large and showy fls. Mex. B.M. 4743.—*A. Skinneri*, Gord.,=A. hirsuta.—Garden forms and hybrids are *A. floribúnda*, *A. intermèdia*, *A. Jàyii*, *A. Mountfórdii*, *A. nægelioidea*, *A. nàna*, *A. venústa* (P.M. 15:121), *A. Verschaffèltii*.

L. H. B.

ÀCHLYS (the goddess of obscurity). *Berberidàceæ*. Hardy herbaceous perennial allied to the may-apple, and sometimes so called where wild. Lvs. all radical, with 3 lfts.: fls. minute, apetalous, numerous, spicate, on a slender scape: fr. very small, at first pulpy but becoming dry.—Species 2, one of them Japanese.

triphýlla, DC. Rootstock terminated by a strong, scaly winter-bud: lvs. 1 or 2, on petioles 1 ft. or more long; lfts. fan-shaped, sinuate-dentate, 2½ x 5 in.: scape 1 ft. long: spike 1 in. long. Spring. Calif. to Brit. Col., in shady woods.—An interesting and delicate plant. Intro. 1881.

ÁCHRAS: *Sapodillo.*

ACHYRÁNTHES: *Iresine.*

ACIDANTHÈRA (from *akis*, a cusp, and *anthera*, an anther, in allusion to cuspidate anthers). *Iridàceæ*. Tender herbaceous perennials.

Leaves many, linear, ensiform, 1–1½ ft. long: spikes 3–6-fld., simple, lax: fls. long-tubed, the tube slightly dilated upwards; stamens unilateral, inserted at or below the throat: corms roundish, flattened, covered with a matted fiber. Natives of Trop. and S. Afr., and intermediate between Gladiolus and Ixia.

The propagation is by seed or by the numerous corms.

bícolor, Hochst. Fig. 108. St. 15–18 in.: fls. creamy white, blotched chocolate-brown within, fragrant: corms ½–1 in. diam. Abyssinia. G.F. 1:486, 487 (adapted in Fig. 108). Gn. 47:343. G.C. III. 20:393. Mn. 8:11.—Requires a somewhat stiffer soil than the tender species of gladiolus. May be grown in a tub outdoors during summer, and flowered within during Oct. Several corms in a large pot give good results. Corms should be dried as soon as lifted, to prevent rot.

A. æquinoctiàlis, Baker. St. 3–4 ft., stout, stiffly erect: lvs. strongly ribbed: fls. about 6 in a distichous spike, the tube 5–6 in. long, white, blotched crimson or purple within: corms large. Sierra Leone. B.M. 7393. May be a stronger-growing and more tropical form of the above. Requires warmhouse culture.—*A. cándida*, Rendle. A slender, erect, leafy herb: fls. white, very sweet-scented. Trop. E. Afr. B.M. 7879.

N. TAYLOR.†

ACINÈTA (*immovable*, referring to the jointless lip). *Orchidàceæ*. Epiphytic hothouse orchids.

Pseudobulbs conic or ovate, with the large plicate-veined lvs. articulated to the summit: fls. fleshy, borne in pendulous racemes on lateral leafless scapes; sepals broad, equal, finally somewhat spreading; petals similar to the sepals but smaller; lip fleshy, continuous with the base of the column, the middle lobe continuous or articulated, entire or 3-lobed; pollinia 2.—About 10 species, distributed from Mex. to northern S. Amer.

These plants require a warm house and plenty of moisture during the growing season, with a decided rest, to make them flower. They need to be cultivated in wooden baskets and suspended from the roof of the house, as the flower-spikes are always produced from the base of the bulbs and there should be no hindrance in the way of crocks to prevent their egress. The rooting material may be peat fiber only, and not a great quantity under the plants, but plenty around them. With basket culture of orchids, it is very necessary, once a week in the growing season, to take the plants down and give a soaking by immersion, in addition to the ordinary spraying overhead from day to day; in this way alone can one be sure of the proper growing conditions. In winter, much less water is required. Propagation is by division of the plants in spring. (Orpet.)

Bárkeri, Lindl. (*Peristèria Bárkeri*, Batem.). Fig. 109. Pseudobulbs conic, 4–5 in. long, usually bearing 3 or more lvs. 2–3 ft. long: fls. yellow, striped with red-brown, 12 or more, in pendulous racemes. Mex. B.M. 4203. I.H. 2:44. Gn. 54, p. 332. P.M. 14:145. G.M. 40:697.

Húmboldtii, Lindl. (*Peristèria Húmboldtii*, Lindl. *A. supérba*, Reichb.). Pseudobulbs ovate, about 3 in. long, bearing 3 or 4 lvs. about 1 ft. long: fls. chocolate, spotted with crimson, 6 or more, in pendulous racemes. Mts. of N. S. Amer. Gn. 3:11; 32, p. 157; 25, p. 482. Var. **Côlmanii,** Hort. Fls. profusely spotted with purple.

A. chrysántha, Lindl. Fls. golden yellow, the lip whitish, and the column purplish or crimson. Mex.—*A. dénsa*, Lindl. (*A. Warscewiczii*, Klotzsch). Fls. in a dense raceme, pale yellow, externally spotted with reddish brown, fragrant; lip yellow, marked with crimson. Costa Rica. B.M. 7143.—*A. Hrubyàna*, Reichb. Fls. white, the lip spotted with purple. Colombia.—*A. Moòrei*, Rolfe. Fls. straw-colored, sub-globose, thickly brown-spotted;

the lip fleshy, the lateral lobes obliquely reniform, the midlobe oblong, blunt. S. Amer. B.M. 8392.—*A. sulcàta*, Reichb. f. Fls. yellow; otherwise similar to A. Humboldtii.

GEORGE V. NASH. †

ACIPHÝLLA (Greek for *sharp-leaved*). *Umbellíferæ*. About a dozen or so herbs, all of New Zealand except 2 in the mts. of Austral., sometimes seen in rock-gardens but apparently not grown in N. Amer. Plant erect, and rigid, somewhat spiny, with thick pinnate lvs., and the small fls. in compound bracted umbels. Some of them are large plants. Allied to Ligusticum.

ÀCIS: *Leucojum*.

ACOCÁNTHÈRA (*mucronate anthers*). Sometimes spelled *Acokanthèra*. Syn., *Toxicophlœa*. *Apocynàceæ*. A genus consisting of 5 species of African shrubs, cult. in greenhouses N., and outdoors in Fla. and Calif. Fls. with the odor of jasmine, lasting; calyx 5-parted, glandless; corolla 5-parted, its 5 lobes twisted. In Cent. Fla., they require some protection during the winter. Prop. by cuttings taken early in the spring.

spectábilis, G. Don (*Toxicophlœa spectábilis*, Sond. *T. Thúnbergii*, Hort., not Harv.). WINTER-SWEET. Lvs. 3–5 in. long, short petiolate, leathery, elliptic, acute, shining above: fls. numerous, in dense, axillary, branched cymes, which are sometimes 2 ft. long, pure white, very sweet-scented: fr. blackish purple, almost as large as an olive and of the same form; contains one large, nut-like seed. Natal. B.M. 6359. R.H. 1879:270. G.F.6:185. G.C. 1872:363.—Poisonous. The plants cult. under this name are said by trade catalogues to have pink or violet fls.

venenàta, G. Don (*Toxicophlœa cestroìdes*, DC. *T. Thúnbergii*, Harv., not Hort.). BUSHMAN'S POISON. Fls. white or rose. Differs from the above in the well-marked venation of the lvs., its fls. a third smaller, its calyx not pubescent, and its corolla-limb less widely spreading. I. H. 32: 553. R.H. 1880:370.

N. TAYLOR.†

109. Acineta Barkeri. (×⅙)

ACŒLORRHÀPHE (name of uncertain origin). *Palmàceæ*, tribe *Corỳpheæ*. A genus of 2 species of American palms allied to Brahea and distinguished from it by technical characters of the albumen. **A. Wrìghtii**, Wendl., a graceful, slender palm with almost orbicular-bladed lvs.: trunk thin, scarcely exceeding 4–7 ft.: lvs. long-petioled, made up of about 50 narrow segms., all united at the base. Cuba and Honduras. —Has been cult. outdoors at the botanic gardens at Buitenzorg and Calcutta and in extreme S. Fla. Unique but little known outside of botanic gardens. Grows with great vigor in rich moist soil.

N. TAYLOR.

ACONITE, WINTER: *Eranthis*.

ACONÌTUM. *Ranunculàceæ*. ACONITE. MONKSHOOD. WOLFSBANE. A group of hardy ornamental, perennial herbs, much used in borders and masses for their showy flowers and effective foliage.

Root tuberous, turnip-shaped, or thick-fibrous: st. tall or long, erect, ascending or trailing: lvs. palmately divided or cleft and cut-lobed: fls. large, irregular, showy; sepals 5, the large upper sepal in shape of a hood or helmet; petals 2–5, small; stamens numerous; carpels 3–5, sessile, many-ovuled, forming follicles when ripened. The number of species varies from 18–80, with different botanists. Native in mountain regions of Eu., Temp. Asia, and 5 in N. Amer. Reichenbach Monographia Generis Aconiti, Leipsic, 1820, 2 vols., folio; Illustratio Specierum Aconiti, Leipsic, 1822–7, folio. Many species are planted in European gardens, but only a few have been much used in Amer.

108. Acidantnera bicolor. (×⅓)

The aconitums yield important drugs, although none of them is grown for this purpose in this country. The officinal aconite is derived from the roots of *A. Napellus* from England and continental Europe. The leaves are also used for medicinal purposes. *A. japonicum* yields Japanese aconite; *A. chinense*, the Chinese aconite; and *A. ferox* the "bish" or Nepaul aconite. The poisonous alkaloid *aconitin* is secured from *A. Napellus*, and similar alkaloids from *A. ferox*, *A. luridum* and *A. palmatum*, of India, *A. Fischeri*, *A. Lycoctonum*, *A. septentrionale*. Not all these species are described here, as they are not horticultural subjects.

These plants present a pleasing contrast to the yellow helianthus and rudbeckias, the white of *Phlox paniculata*, to *Chrysanthemum maximum* and *Anemone japonica*. They are also effective for mixing in on shrub borders. The first season, these herbs do not attain their full perfection. Aconitums should be left undisturbed as long as possible. They will survive the northern winters if kept under a leaf-covering, while for the central part of the country, straw or evergreen boughs are sufficient protection.

The following species do well in any garden land, but respond better if given very rich soil. They thrive in open sun, but flowers last longer in shaded places. Aconites should never be planted in or too near the kitchen-garden or the children's garden, as the roots and some of the flowers have a deadly poison. They are suited to the back of the border, as they are tall.

Propagation is effected easily by division of roots in either late fall or early spring; also by seeds sown as soon as mature, in warm spring, in the North, the seeds may be started in small seed-beds in the spring and then be transplanted when the seedlings are about 2 inches high. In the Central States and southward, a year is gained by sowing the seed in late summer or early fall.

A. *Roots globular-tuberous.*

B. *Lvs. deeply cut, but not to the base.*

Fischeri, Reichb. (*A. columbiànum*, Nutt. *A. califórnicum*, Hort.). Sts. 4–6 ft.: lvs. large, smooth, 3-

parted, attractive; segms. much cut and divided: fls. numerous, pale blue, panicled, pedicels pubescent; helmets hemispherico-conical. Autumn. N. Amer. and Asia. F.S.R. 1:214. R.B.33:205 (as *A. sinensis* var. *bicolor*). Var. **Wilsonii** (*A. Wilsonii*, Stapf), is a very tall form, with violet fls. R.H. 1910, p. 223. Gn. W. 21:197. Gn. 64, p. 339. B.M. 7130 (as *A. Fischeri*).

Cammàrum, Linn. (*A. décorum*, Reichb. *A. exaltàtum*, Bernh.). St. 3–4 ft.: lvs. with short, bluntish lobes: fls. purple or blue; panicles or loose spikes few-fld; helmet hemispherical, closed. July–Sept. Hungary. Intro. 1889.—*A. Storkiànum*, Reichb., is a dwarf form of this, with fewer fls. and somewhat fibrous roots.

uncinàtum, Linn. WILD MONKSHOOD. Fig. 110. St. slender, 3–5 ft., inclined to climb: lvs. thick, deeply cut into 3–5 cut-toothed lobes: fls. loosely panicled, but crowded at the apex, blue, pubescent, 1 in. broad; helmet erect, nearly as broad as long, obtusely conical: follicles 3. June–Sept. Low grounds of Pa., S. and W. Japan. Mn. 4:81.—Much planted now.

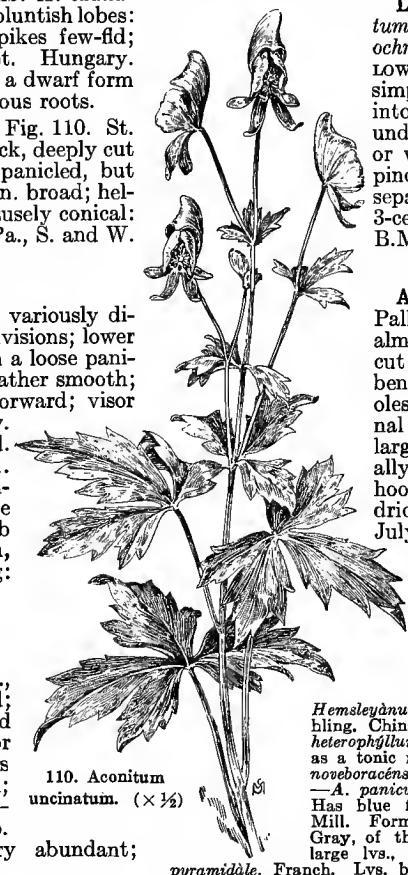
BB. *Lvs. divided to the base.*

variegàtum, Linn. Erect, 1–6 ft.: lvs. variously divided into usually broad lobes and cut divisions; lower petioles long, others short or none: fls. in a loose panicle or raceme, blue, varying to whitish, rather smooth; helmet higher than wide, top curved forward; visor pointed, horizontal or ascending. July. Eu.—*A. álbum*, Ait., is a pure white-fld. form of this, with rather fibrous roots. *A. volùbile*, var. *latiséctum*, Hort., is a twining form of *A. variegatum*. The plants are allowed to ramble naturally or to climb on arbors; height 8 ft. Var. **tenuiséctum**, Hort. Sts. slender though not twining: large blue fls. Manchuria.

AA. *Roots long-tuberous.*

B. *Carpels usually 5.*

japónicum, Decne. St. erect, 3–4 ft., smooth: lvs. dark green, shining, petioled; lobes 2–3 times cut, the parts blunt and deeply toothed: fls. large, deep blue or violet, tinged with red, on loose panicles with ascending branches; helmet conical; beak abruptly pointed: follicles 5. July–Sept. Japan. Intro. 1889. R.H. 1851, p. 475. Var. **cærùleum**, Hort. Fls. very abundant; panicles shortened.



110. Aconitum uncinatum. (×½)

BB. *Carpels 3 or 4.*

Napéllus, Linn. (*A. taúricum*, Jacq. *A. pyramidàle*, Mill. *A. inúnctum*, Koch). TRUE MONKSHOOD. OFFICINAL ACONITE. Fig. 111. The best known and most poisonous species, and used in medicine. Sts. erect, 3–4 ft.: lvs. divided to the base, and cleft 2–3 times into linear lobes: fls. blue, in a raceme; peduncles erect, pubescent; helmet broad and low, gaping, smoothish: fr. 3–4-celled. June, July. Gn. M. 4:34. R.V. 8:2. Gn. 12, p. 362.—Very many varieties, differing in shade of fls., often mottled or lined with white. Var. **álbum** is nearly white. Var. **bícolor** and var. **versícolor,** much used in gardens for the large blue and white fls. Reichenbach has divided this species into 20–30 species. *A. Hálleri* is one of his divisions appearing in catalogues. B.M. 8152 (as var. *Emnicus*).

111. Aconitum Napellus. (×⅛)

AAA. *Roots in the form of a scaly, elongated bulb, or somewhat fibrous.*

B. *Sepals deciduous.*

autumnàle, Reichb. AUTUMN ACONITE. Fig. 112. St. 3–5 ft.: lvs. pedately 5-lobed: fls. in a simple spike, becoming a panicle, blue, lilac, or whitish; helmet closed. Sept.–Nov. N. China.

Lycóctonum, Linn. (*A. barbàtum*, Patr. *A. squarròsum*, *A. ochroleùcum*, Willd.). PALE YELLOW WOLFSBANE. St. slender, simple, 3–6 ft.: lvs. deeply cut into 5–9 lobes; long petioles and under ribs pubescent: fls. yellow or whitish, in racemes; helmet a pinched elongated cone; middle sepals usually bearded: fr. usually 3-celled. June–Sept. Eu., Siberia. B.M. 2570. G.M. 34:124.

BB. *Sepals persistent.*

Anthòra, Linn. (*A. pyrenàicum*, Pall.). St. 1–2 ft.: lvs. parted almost to the base, parts deeply cut and lobed, more or less hispid beneath, smoothish above; petioles long: fls. in lateral and terminal racemes, pale yellow, often large; racemes or panicles generally pubescent; spur bent back or hooked; helmet arched, but cylindrical at base: follicles 5. June, July. S. Eu. B.M. 2654. Var. **aùreum,** Hort., and several other varieties.

A. chinènse, Sieb. Deep blue spike of fls. from the axil of every lf.: foliage bold and handsome. B.M. 3852. P.M. 5:3.—*A. delphinifòlium*, DC. Allied to A. Napellus.—*A. gymnándrum*, Maxim., is a good species. B.M. 8113.—*A. Hemsleyànum*, E. Pritz. Sts. twining and rambling. China. R.B. 33, p. 328. G. 32:39.—*A. heterophýllum*, Wall. Fls. yellow and violet. Used as a tonic medicine in India. B.M. 6092.—*A. noveboracénse*, Gray. Probably=A. paniculatum.—*A. paniculàtum*, Lam. (A. toxicum, Reichb.). Has blue fls. L.B.C. 9:810.—*A. pyramidàle*, Mill. Form of A. Napellus.—*A. reclinàtum*, Gray, of the Alleghanies, with white fls. and large lvs., is worth cult.—*A. scapòsum* var. *pyramidàle*, Franch. Lvs. broadly 5-lobed: fls. very numerous, ¾–1 in. long, heliotrope, greenish yellow at the throat. Cent. China.—*A. septentrionàle* var. *carpáticum*, Sims, is a beautiful purple kind closely related to A. Lycoctonum. B.M. 2196.—*A. Storkiànum*, Hort., may be a form of A. variegatum, with the lvs. so much cut up as to give a pinnate form.—*A. tortuòsum*, Willd. Once listed in the trade; not now found.

K. C. DAVIS.

ÁCORUS (ancient name of unknown meaning). *Aràceæ*. Hardy, herbaceous water-loving plants. Lvs. sword-shaped, erect: spadix appearing lateral, with no true spathe; fls. inconspicuous. They thrive best in moist soil, and may be grown in shallow water or on dry land. Prop. easily in spring or autumn by division.

Cálamus, Linn. SWEET FLAG. Height 2 ft.: rootstock horizontal, pungent, aromatic: fls. early summer. N. Amer., Eu. V. 2:198. Var. **variegàtus,** Hort. Lvs. striped deep yellow when young, fading to a paler color later in summer. Eu.—Commoner in cult. than the type.

gramíneus, Soland. Height 8–12 in. Much smaller than *A. Calamus*, forming compact, grassy tufts. Japan. Var. **variegàtus,** Hort. Lvs. striped white.—Used in hanging-baskets, vases, rockeries and for cutting. Often grown indoors.

A. japónicus argénteo-striàtus, Hort., and *A. japónicus fòlia variegàtus*, Hort., are catalogue names, and are referable, from description, to A. gramineus, Soland. var. variegatus, Hort.

GEORGE V. NASH.†

ACRIÓPSIS (Greek combination for *top* and *eye*). *Orchidàceæ*. A few epiphytic orchids from the E. Indies, with panicles of small fls. with colors in green, pink, yellow and purple, and little known in cult. **A. latifòlia,** Rolfe, has very broad lvs. and very small whitish yellow red-striped and spotted fls.

ACRÍSTA (origin of name unexplained). *Palmàceæ*, tribe *Arèceæ*. A tall palm suitable for planting S.

Leaves pinnate, usually very large, from 10–20 in a terminal crown: infl. usually maturing well below the lvs; the spadix 1-branched, the branches coarse, tapering.—Only 1 species, *A. monticola*, confined to Porto Rico, Cuba and St. Kitts. The nearest relative, the royal palm, differs in having a bulging trunk, and in having 2–3-branched infls. See Bull. Torrey Club, 28:555 (1901).

This palm is not as yet common, but well worthy of a wider cultivation. It resembles the royal palm but is shorter, and has a smooth trunk of uniform diameter. For cultivation see *Palms*.

montícola, O. F. Cook. Thirty-five to 45 ft.: trunk smooth, with many ring-like scars: lvs. about 6 ft., the lfts. lanceolate in one plane, equally spaced, and nearly at right angles to the rachis: infl. coming out between the lvs., and by the dropping of latter, appearing well below the lf.-crown at maturity; fls. not well known: fr. with lateral stigma, grayish brown, nearly smooth, obovate, ½ x 1 in. Bull. Torrey Club, 28, pl. 44 (as *Thrincoma alta*).

N. TAYLOR.

112. Aconitum autumnale. (× ½)

ACROCLÍNIUM: *Helipterum*.

ACROCÒMIA (name means *a tuft of leaves at the top*). *Palmàceæ*, tribe *Bactridíneæ*. A showy genus of American palms. Not popular in the trade because of their spiny habit and rather unattractive young state. The adult plants, however, are very graceful.

Leaflets narrowly linear, long, usually obliquely acuminate, the margins naked and recurved, the midrib often spiny on lower sides of lfts.; rachis and petioles usually hairy, always more or less spiny: fls. yellowish, monœcious, the spathes ultimately becoming woody; calyx small, of 3 ovate sepals; corolla of 3 oblong-lanceolate or ovate petals: fr. usually about 1 in. diam., glabrous or sometimes prickly or tomentose. —There are only 8 species, all natives of Trop. Amer. except *A. Totaï*. Most closely related to Cocos, from which the Amer. species differ in having spines. See G.C. II. 22:427. Bull. Torrey Club, 28:565.

These palms are usually spiny and have large, terminal, pinnate leaves. All except *A. Totaï* should be grown in a warmhouse, with a night temperature not lower than 60°. They should be potted in soil similar to that for the coconuts, and, if possible, planted out directly. It has been found by some that overpotting the young plants is a danger likely to be incurred. The palms grow slowly and should not be transferred to a new pot until they become almost pot-bound.

Propagation is by suckers, which come freely in most species. Seeds are not known in cultivation for any of the species except *A. sclerocarpa*.

A. *Trunk greater in diam. a few ft. above the ground than elsewhere; spines 5-6 in. long.*

mèdia, O. F. Cook. Trunk 20–30 ft., conspicuously thickened above the ground; spines slender, black, mostly confined to the lower half of the internodes: lvs. opening about as they are pushed out, not spire-like, as in the royal palm, forming a dense crown; lfts. coming out from the rachis at all angles: fr. about 1½ in. diam., fibrous on the outside, yellowish. —A magnificent palm, known only from U. S. and not common outside of fanciers' collections and botanic gardens.

AA. *Trunks of essentially uniform diam. near base; spines 1–4 in. long.*

B. *Lvs. more or less spreading, and sometimes drooping: trunk predominately spiny throughout, 10–20 ft.*

mexicàna, Karw. Trunk brown-woolly, and covered with stout spines 1–3 in. long: lvs. terminal, 6–8 ft. long, the sheathing bases armed with long black spines; rachis and petiole spiny; lfts. rather stiff, linear, and shining: spathe very spiny: fr. globose, about 1 in. diam. Mex.—This palm is said to be perfectly hardy at Santa Barbara, Calif.

BB. *Lvs. more or less stiff and erect: trunks predominately more spiny above than below, 30–40 ft.*

sclerocárpa, Mart. (*A. aculeàta*, Lodd.). Fig. 113. Height 30–45 ft.: trunk cylindrical, about 1 ft. thick, with black spines 2–4 in. long, more common toward the summit than below: lvs. 12–15 ft. long, more or less erect; segms. in irregular groups of 2 or 3, 2–3 ft. long, ¾–1 in. wide, smooth and shining above, whitish, appressed-pilose below, entirely free of spines, except along the midrib on the under side; rachis tomentose, and bearing a few small spines: fr. yellowish, a little more than 1 in. diam. Brazil to W. Indies. I.H. 15:547.—Not hardy at Oneco, Fla. Cult. in Calif. but apparently not out-of-doors. "Gru-gru" and "corozo" are native names of this palm.

Totaï, Mart. Trunk 30–40 ft., about 10–15 in. diam., clothed with stout spines, especially near the summit: lvs. not so large as in the preceding, green and glabrous on both sides; petioles tomentose and a little spiny: spathe very spiny, the fls. yellowish: fr. globose, yellow, a little less than 1 in. diam., scarcely known in cult. specimens. Paraguay and Argentine, perhaps in Brazil.—May be grown in coolhouse. Offered in 1912 by Reasoner Bros., Oneco, Fla.

113. Acrocomia sclerocarpa.

A. havanénsis, Hort. A slow-growing, thorny plant, of which little is known; a trade name.

N. TAYLOR.

ACROPÈRA: *Gongora*.

ACROPHÝLLUM (Greek, *top* and *leaf*). *Cunoniàceæ*. A monotypic genus allied to Cunonia, containing the Australian evergreen shrub, **A. venòsum,** Benth. (*A. verticillàtum*, Hook.), excellent for spring flowering in the coolhouse. Prop. by cuttings in early summer. Let the plant rest during summer. Do not expose to frost. It produces many pinkish fls. in dense spicate whorls near the top of the branches. Lvs. in 3's, nearly all terminal and above the fls., sessile, dentate or serrate, cordate and acute: fls. with 5 petals and 10 stamens: 4–6 ft. B.M. 4050 (as *A. verticillatum*).

N. TAYLOR.†

ACROSPÌRA (name of ambiguous application) *Liliàceæ*. One species, *A. asphodeloìdes*, Welw., from Trop. Afr., with the habit of Eremurus, and white fls. in spikes; has been offered in Eu.

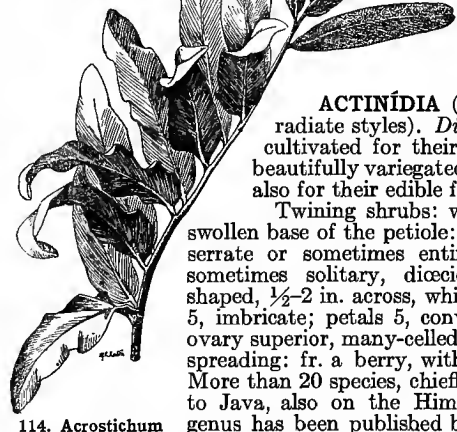
ACRÓSTICHUM (derivation uncertain). *Polypodiàceæ*. As properly delimited, a small genus of coarse tropical swamp ferns, sometimes grown under glass.

Stem stout, erect: lvs. clustered, erect, once-pinnate, 3–8 ft. high: sporangia completely covering the backs of some or all the pinnæ of the fertile lvs.

aùreum, Linn. Fig. 114. Three to 8 ft. long, with pinnæ 6–10 in. long, short-stalked, coriaceous: sporangia only on upper pinnæ of fertile lvs. Fla. to Brazil and in the tropics of the Old World. S. 1:187.—Strong-growing. One of the best. Should be treated as an aquatic.

excélsum, Maxon (*A. lomarioìdes*, Jenman). Similar in size to preceding: sterile lvs. also similar. Distinguished by having sporangia on all the pinnæ of the fertile lvs. Fla. to Brazil.

Acrostichum has been considered to include a much larger array of species, including, as in the previous editions of the Cyclopedia of Horticulture, ferns of very diverse form and habit of growth. Fern students, however, are now united in distributing the species of Acrostichum as formerly understood among several genera. Thus the species included in Acrostichum in the former Cyclopedia are here grouped in several genera as follows: **Acrostichum**: (as above). **Elaphoglossum**: *conforme, crinitum, flaccidum, gorgoneum, muscosum, pilosum, reticulatum, simplex, squamosum, vicosum, villosum;* **Leptochilus**: *alienum, nicotianæfolium*; **Olfersia**: *cervina;* **Polybotrya**: *osmundacea;* **Rhipidopteris**: *peltata;* **Stenochlæna**: *scandens, sorbifolia.* R. C. BENEDICT.



114. Acrostichum aureum. (×¼)

ACTÆA (ancient name of the elder, transferred by Linnæus). *Ranunculàceæ*. ACTEA. BANEBERRY. COHOSH. Native hardy herbacous perennials. Sometimes offered in collections of hardy border plants. Not to be confounded with blue cohosh, which is Caulophyllum.

Leaflets of the twice- or thrice-ternate lvs. ovate, sharply cleft, and cut-toothed: fls. small, white, in terminal racemes; sepals 4 or 5, falling early; petals 4–10, clawed; stamens many: fr. a many-seeded berry.

Acteas are grown chiefly for the showy spikes of small white flowers in spring, and handsome clusters of berries in autumn. Useful for rockery and wild garden, or for clumps and borders. They thrive in rich woods and shade.

Propagation is by seeds sown in late fall to germinate the next spring or sown in spring. Old seed is said not to germinate well. A more satisfactory means of propagation is by root-division in spring.

álba, Mill. (*A. rùbra*, Bigel.). WHITE BANEBERRY. Height 1–1½ ft.: much like *A. spicata*, but the lfts. more cut, teeth and points sharper; plant smoother: fls. white, in an oblong raceme, and a week or two later: pedicels in fr. very thick, turning red; berries white, ovate-oblong, often purplish at the end. N. states.

spicàta, Linn. COHOSH. HERB-CHRISTOPHER. Plant 1–2 ft.: lvs. bi- or triternate, serrated: fls. white or bluish, in ovate racemes in Apr. to June: berries purplish black, oblong. Eu., Japan.—Less cult. than the red-fruited variety. Figured as *A. racemosa* in G.W. 5:4 and 14:507. Figured as *A. japonica* in G.M. 50:28 and G.W. 5:3 and 15:173.

Var. **rùbra**, Ait. (*A. rùbra*, Willd.). RED BANEBERRY. Rather taller than *A. alba:* lvs. bi- or triternate, serrated: fl.-cluster white, larger than in *A. spicata:* berries bright red, very handsome. Northern states.

Var. **argùta**, Torr. Sts. rather taller than var. *rubra:* lfts. very deeply incised: racemes elongated in age: berries either red or white. Neb., W., and N. W.
K. C. DAVIS.

ACTINÉLLA (Greek, *small-rayed*). *Tetraneùris*, Greene. *Compósitæ*. Hardy perennials from W. N. Amer., for cult. in alpine gardens and the open border. Height 6–12 in.: fls. tubular and radiate, yellow; bracts of the involucre appressed; rays 3-toothed.—Of easy culture in light soil. Prop. by division of the roots in spring, or by seeds.

grandiflòra, Torr. & Gray (*Rydbérgia grandiflòra*, Greene). Plant densely woolly: lower lvs. pinnately or bipinnately parted, with margined petioles from broad, scarious bases; upper cauline lvs. simple or sparingly divided: fls. 2–3 in. wide; summer.—A pretty alpine plant.

scapòsa, Nutt. Plant villous: lvs. radical, linear-spatulate, 2–3 in. long, punctate, entire: fls. 1 in. wide; scapes single, leafless, 1-fid., 3–9 in. long.

A. lanàta, Pursh=Eriophyllum cæspitosum.—*A. lanàta*, Nutt. Short, densely hairy lvs. with scape 5–9 in. long. Summer.
N. TAYLOR.†

ACTINÍDIA (*aktis*, ray; referring to the radiate styles). *Dilleniàceæ*. Climbing shrubs cultivated for their handsome foliage which is beautifully variegated in some species, and a few also for their edible fruit.

Twining shrubs: winter-buds inclosed in the swollen base of the petiole: lvs. alternate, long-stalked, serrate or sometimes entire: fls. in axillary cymes sometimes solitary, dicœcious or polygamous, cup-shaped, ½–2 in. across, white or rarely reddish; sepals 5, imbricate; petals 5, convolute; stamens numerous; ovary superior, many-celled; styles numerous, ray-like spreading: fr. a berry, with numerous small seeds.—More than 20 species, chiefly in E. Asia from Saghalin to Java, also on the Himalayas. A revision of the genus has been published by Dunn in Jour. Linn. Soc. Bot. 39:394–410 (1911).

About 7 species are in cultivation; of these *A. Kolomikta* is the hardiest, growing as far north as eastern Canada; *A. arguta* and *A. polygama* are hardy in Massachusetts, while *A. chinensis*, which is the most beautiful of all, and *A. coriacea*, are hardy only south of Washington, but may be grown farther north if taken down in autumn and covered with leaves. *A. arguta* is excellent for covering arbors, trellises, walls and the like and is remarkably free from insects and fungi. *A. Kolomikta* and *A. polygama* show a very striking silvery white or pinkish variegation of the foliage, which is more pronounced in the staminate plant. *A. arguta* and *A. chinensis* are also worth cultivating for their edible fruits, particularly the latter, which has fruits up to 2 inches long, of a gooseberry-like flavor; to obtain fruit, it is necessary to plant both sexes or a plant with polygamous flowers. *A. polygama*, and, in a lesser degree, *A. Kolomikta*, attract cats and are often destroyed by them if not protected by screens.

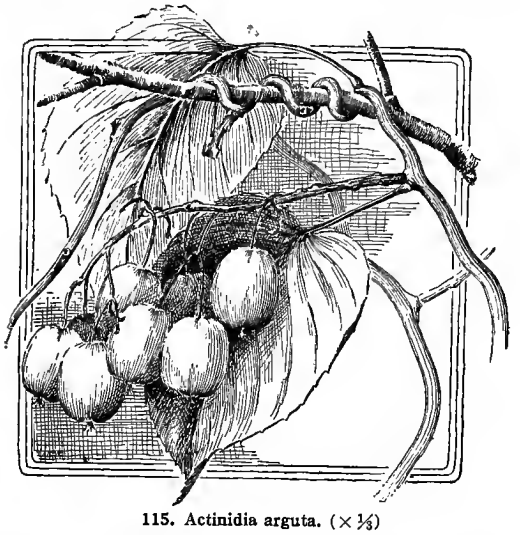
The actinidias prefer somewhat moist and rich soil and grow as well in a sunny as in a half-shady position.

Propagation is by seeds, which are sown in spring and germinate readily; also by cuttings, of half-ripened wood in summer or by hardwood cuttings under glass, and also by layers.

A. *Branchlets glabrous: lvs. glabrous beneath or only pubescent on the veins, acuminate.*

B. *Lvs. dark green, shining above, chartaceous, never variegated: anthers dark purple.*

argùta, Miq. (*A. polýgama,* Lauche, not Miq. *A. volùbilis,* Carr., not Miq. *A. rùfa,* Miq.). Fig. 115. High-climbing: branches with brown lamellate pith: lvs. broad-elliptic or broadly ovate, 4–5 in. long, cuneate to subcordate at the base, setosely appressed serrate, glabrous beneath except the setose midrib:



115. Actinidia arguta. (×⅓)

fls. 3 or more, white, ¾in. across; sepals elliptic-oblong, tomentulose; petals brownish at the base: fr. subglobose, greenish yellow, about an inch long, sweet. June. Japan, Korea, Manchuria. L.I. 25. R.H. 1874, p. 394. B.M. 7497 (as *A. polygama*). A.G. 1891:147. M.D.G. 1895:97; 1898:378. G. 29:503.

BB. *Lvs. bright green, membranous, often variegated: anthers yellow: fls. 1–3.*

polýgama, Maxim. To 25 ft.: pith of branches solid, white: lvs. broadly ovate to ovate-oblong, 3–6 in. long, rounded or subcordate at the base, appressed serrate, mostly setose on the veins beneath, variegation white or yellowish: fls. white, ¾in. across; ovary bottle-shaped: fr. yellow, bitter. June. Japan, Korea, Manchuria to Cent. and W. China.—Known as silver vine on account of the beautiful silvery white color of the young lvs. of the staminate plant.

Kolomíkta, Maxim. Climbing 15 ft. high: pith of branches lamellate, brown: lvs. ovate-oblong, 4–5 in. long, rounded or cordate, unequally setosely serrate, pubescent on the veins beneath, variegation white or pink: fls. white, ¾in. across; ovary cylindric: fr. oblong-ovoid, blue, sweet. June. Japan, Saghalin, Manchuria, Cent. and W. China. R.H. 1898:36. M.D.G. 1896: 397. G.W. 3, p. 61.—The staminate plant is very striking with its beautifully white and carmine variegated young lvs.

AA. *Branchlets densely hairy: lvs. tomentose beneath, usually rounded or emarginate at the apex.*

chinénsis, Planch. Climbing, to 25 ft.: hairs of young branchlets and lvs. bright red; pith of branches lamellate: lvs. orbicular or oval, cordate, firm, 3–5 in. long, ciliate-serrulate, finally glabrous above and dark green, whitish beneath: fls. several, creamy white, 1½–2 in. across: fr. ovoid or subglobose, 1–2 in. long, hairy, edible. China. G.C. III. 46:77 and 79. R.H. 1909, p. 473. J.H.S. 1903:59. H.I. 16:1593.—The most beautiful of the actinidias with the largest fls. and a promising fruiting vine; the frs. have the flavor of a gooseberry.

A. callòsa, Lindl. Similar to A. Kolomikta. Branchlets with conspicuous lenticels, with lamellate pith: lvs. oval to oblong, 3–5 in. long, serrulate, quite glabrous: fls. white, ½ in. across: fr. ovoid, spotted, 1 in. long. China.—*A. coriàcea,* Dunn. Allied to the preceding species. Lvs. coriaceous, oblong to lanceolate, remotely serrate, 3–4 in. long; petioles less than 1 in. long: fls. several, reddish: fr. ovoid, spotted, ½–¾in. long. China. Recently offered under the name of A. Henryi, which is a totally different species, allied to A. chinensis.—*A. melandndra,* Franch. Allied to A. arguta. Lvs. ovate-oblong or oblong, closely serrulate: staminate corymbs many-fld.; petals greenish at the base: fr. purple. China.

ALFRED REHDER.

ACTINÓLEPIS (Greek, *a scale-like ray*). *Compósitæ.* About 6–8 species of hardy annuals, mostly from Calif.; freely branching, and mostly yellow-fld. The fls. are in pedunculate heads at the tips of the branches; rays usually 2–3-toothed, in one series: lvs. opposite. Considered by da Della Torre and Harms to be a section of the genus Eriophyllum, and by Gray to belong properly to Baeria.

coronària, Gray (*Shórtia califórnica,* Hort. *Baèria coronària,* Gray). Fig. 116. Lvs. opposite, except the upper ones, 2 in. or more long, pinnately, or the lower ones bipinnately, parted into linear, narrow divisions: pappus of awned or of muticous, often erose paleæ, rarely wanting. B.M. 3828 (as *Hymenóxys califórnica*). —One of the prettiest of annual fls., and deserving of greater popularity. Excellent for edging. An everlasting.

N. TAYLOR.†

ACTINÓMERIS (from Greek *aktis,* ray, and *meris,* part, alluding to the irregularity of the rays). *Compósitæ.* Native hardy herbaceous perennials suitable for wild gardens and shrubbery.

Tall, branching, yellow-fld. herbs, with aspect of native sunflowers, but with smaller fls.: lvs. often decurrent on the stem: fls. in corymbose or solitary heads, composed of both ray and tubular fls.—Cult. like Helianthus. Prop. by division.

squarròsa, Nutt. (*Verbesìna alternifòlia,* Linn.). Height 4–8 ft.: lvs. lance-oblong, acuminate, toothed, subpetiolate, tapering to both ends: fls. numerous, corymbed, yellow, 1–2 in. across.; rays 2–10, irregular. Autumn. E. N. Amer.

A. helanthoides, Nutt. (Verbesina helianthoides, Michx.). Lvs. silky villous underneath: rays about 8, usually more than in A. squarrosa. Mn. 4:129.—*A. pròcera,* Steud., is only a taller form of A. squarrosa.

N. TAYLOR.†

ACTINÓPTERIS (*aktis,* ray, and *pteris,* the leaves radiately cut). Syn., *Actiniópteris. Polypodiàceæ.* Greenhouse ferns from India, resembling miniature fan-palms. The sori are linear-elongate and submarginal, and covered with indusia. *A. radiàta,* Link (*A. austràlis,* Linn. f.) is the only recognized species. Apparently not in the horticultural trade.

116. Actinolepis coronaria flower.

ACTINOSTÉMMA (*ray* and *wreath* or *stems*). *Cucurbitàceæ.* Three or 4 species of climbing or running plants from China and Japan, of which *A. paniculàtum,* Maxim., has been grown in European collections. It is a hardy perennial in Cent. Eu., with tuberous roots, palmate lvs. and small fls.; said to thrive in dry and barren places.

ÀDA (a complimentary name). *Orchidàceæ.* Epiphytic coolhouse orchids.

Pseudobulbs elongated, bearing at the apex 1–3 coriaceous lvs.: fls. nodding, in a somewhat 1-sided raceme, terminating the lateral leafless scape; sepals nearly equal, free, usually spreading above; petals similar to the sepals but smaller; lip sessile, continuous with the base of the column, entire, shorter than the

sepals; pollinia 2.—Species 2, natives of the Colombian Andes.

Ada aurantiaca is a coolhouse orchid and will thrive well with the odontoglossums where they are cultivated; the bright orange-colored blooms add interest to the collection when in spring display. The culture is

117. Ada aurantiaca. *a* shows the lip and column. (Plant × ⅓)

simple if potted in peat fiber with plenty of drainage; sphagnum may be added if it can be made to grow, but if not it becomes sour and inert, and is best left out of the material for cool orchids. Adas are evergreen and should never be dried at the roots as they grow in boggy soil at 8,500 feet elevation in Colombia. There is another species, *A. Lehmannii*, which is very distinct, but since the unfortunate death of Consul Lehmann, it seems never to have been reintroduced to cultivation. (Orpet.)

aurantìaca, Lindl. Fig. 117. Pseudobulbs 2–3 in. long, usually somewhat compressed, tapering, bearing 1–3 lvs. up to 12 in. long: fls. cinnabar, the sepals and petals lanceolate, twice as long as the lip. B.M. 5435. C.O., pl. 1. G.C. III. 43:247. F.W. 1873:225. Var. **maculàta**, Hort. Sepals and petals spotted with dark brown. C.O., pl. 1*a*. GEORGE V. NASH.

ADAM-AND-EVE: *Sempervivum tectorum*, and *Aplectrum hyemale*.

ADAMÀRA (from a personal name). *Orchidàceæ*. A name proposed by the Royal Horticultural Society of London to cover the multigeneric hybrids of the genera Brassavola, Cattleya, Epidendrum and Lælia, the name *Linneara* being proposed for combinations of certain other orchid genera. The International Congress of Horticulture held at Brussels in 1910 adopted *Linneara* for four genera named above, and legislated that "multigeneric hybrids receive a conventional generic name, preferably that of a distinguished man, to which is added the termination *ara*. A distinct generic name will be formed for each different combination of genera." See *Linneara;* also *Brasso-cattlælia*.

ADÀMIA: *Dichroa*.

ADAM'S APPLE: *Citrus Limetta*, *Musa paradisiaca*, and *Tabernæmontana coronaria*.

ADAM'S NEEDLE: *Yucca*.

ADANSÒNIA (named after M. Adanson, French botanist). *Bombacàceæ*. A genus of 10 species of tropical shrubs and trees, closely related to Bombax: fls. large, pendulous; petals 5, white, obovate; stamens numerous, united in a column about the styles; ovary 5–10-celled: fr. oblong, woody, indehiscent, filled with a mealy pulp in which are numerous seeds.

digitàta, Linn. BAOBAB TREE. Figs. 118, 119. Height not more than 60 ft.: diam. said to be sometimes 30 ft. or more and to have the thickest trunk of any tree in the world: lvs. palmate, with 3 lfts. in young plants, and 5–7 in older ones: fls. 6 in. across, with purplish anthers, on long axillary, solitary peduncles; stigma 7–10-rayed in full anthesis. Afr. B.M. 2791–2792. G.C. III. 27:57.—Rarely cult. in extreme S. Fla., where fr. is 9–12 in. long, and called "monkey's bread." Figs. 118 and 119 are from specimens growing in the American tropics. The fl. opens wide, something like a spreading hibiscus, and the petals soon roll back and wither, as shown in Fig. 119. The tree is very thick-boled, and the wood is soft and light. The tree is supposed to attain to vast age. The fr. of the baobab is a gourd-like structure, of which the pulp is said sometimes to be eaten and the juice used for the making of a beverage. The bark produces a very strong fiber. N. TAYLOR.†

ADDER'S-TONGUE: *Erythronium*.

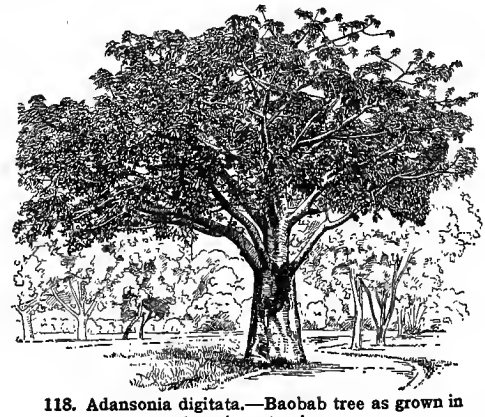
ADDER'S-TONGUE FERN: *Ophioglossum*.

ADÈLIA (Greek, *adelos*, obscure, from the small flowers). *Ricinélla*, Muell. Arg. *Euphorbiàceæ*. Thorny, Trop. American trees, rare in cult. and probably of little horticultural value. Lvs. alternate, short-petioled, clustered on short side branches: fls. dicœcious in axillary clusters or the pistillate single; stamens 8–15. *A. Ricinélla*, Linn., is the best known. Those grown under the name of *A. acidotònis* should perhaps be referred to *Securínega buxifòlia*. J. B. S. NORTON.

ADÈLIA: *Forestiera*.

ADENÁNDRA (from the glandular anthers). *Rutàceæ*. Small, summer-flowering, tender shrubs from the Cape of Good Hope.

Lvs. alternate, small, leathery, subsessile, entire, glandular-dotted: fls. white or rosy, solitary and usually terminal; petals obovate; stamens 5, alternating with 5



118. Adansonia digitata.—Baobab tree as grown in American tropics.

staminodia which are longer than the stamens.—About 20 species. Prop. by cuttings from the ripened wood.

fràgrans, Roem. & Schult. (*Diósma frágrans*, Sims). BREATH OF HEAVEN. Height 2–3 ft.: lvs. oblong, obtuse, dark green above, whitish beneath, with a glandular, denticulate margin: fls. rosy. B.M. 1519.—A favorite in Calif.

The following are sometimes cultivated in botanic gardens: *A. amœna*, Bartl. & Wendl. 1–2 ft.: lvs. oblong or oval, obtuse, glabrous, dotted beneath: fls. white above, reddish beneath.—*A.*

coriàcea, Lichtst. 1–2 ft.: lvs. oblong, obtuse, glabrous, revolute: fls. solitary, terminal, pink.—*A. umbellàta*, Willd. 1–2 ft.: lvs. oblong or obovate, dotted beneath, fringed on the edges: fls. sessile or nearly so, terminal, pink, the petals fringed.—One of the best.

N. TAYLOR.†

ADENANTHÈRA (from the deciduous pedicillate gland on each anther). *Leguminòsæ*. A group of 4 species of tender trees, allied to Mimosa. Lvs. bipinnate or decompound: fls. small, racemose, usually golden yellow or whitish.—The following unarmed evergreen tree is cult. in greenhouses only for its economic interest, and also in Calif. in the open air. Prop. by seeds, which should be softened in hot water previous to sowing.

pavonìna, Linn. RED SANDALWOOD TREE. Lfts. about 13, ovate, obtuse, glabrous on both faces: fls. in an axillary spike-like raceme, white and yellow in the same cluster. Trop. Asia, where it grows to a tree of great size.—The red lens-shaped "Circassian seeds" are curiosities with travelers, and are used for necklaces, and the like. Plant sometimes called "peacock flower fence."

N. TAYLOR.†

ADÈNIA: *Modecca.*

ADENOCALÝMMA, (*glandular covering*; referring to leaves, etc.). Sometimes but incorrectly, spelled *Adenocalymna*. *Bignoniàceæ*. More than 50, mostly Brazilian, species of tender climbing shrubs, closely allied to Bignonia. Fls. large, yellow or orange, bracteate, racemose, trumpet-shaped: lvs. ternate or binate. Grown in hothouses, requiring considerable moisture. Prop. by cuttings in frames.

comòsum, DC. St. rough, punctate: lvs. opposite, trifoliolate; petioles thickened at junction with the blades: racemes so densely clothed at first with large bracts as to suggest the aments of the hop-vine; fls. 2 in. across, brilliant yellow, trumpet-shaped; upper lip of 2, and lower lip of 3 rounded, waved lobes. Brazil. B.M. 4210.

A. nítidum, Mart. 10 ft.: lvs. trifoliolate or unifoliolate tendrilled, the lfts. elliptic-oblong: fls. yellow in axillary and terminal racemes.

N. TAYLOR.†

ADENOCÁRPUS (*aden*, gland, *karpos*, fruit; easily distinguished from allied genera by its glandular pod). *Leguminòsæ*. Ornamental woody plants cultivated chiefly for their yellow flowers.

Shrubs, rarely small trees, more or less pubescent: lvs. alternate, trifoliolate, small: fls. papilionaceous, yellow, in terminal racemes; calyx 2-lipped, the 2 upper teeth free, the 3 lower more or less connate: fr. a glandular pod, oblong or linear, compressed.—About 14 species in S. Eu., Asia Minor, N. and W. Afr., Canary Isls. This genus consists of low shrubs, rarely more than 3 ft., of spreading habit, with handsome fls. produced profusely in spring; very attractive when in full bloom.

They require a sunny position and well-drained soil. They are especially adapted for temperate regions, but do not bear transplanting well, and should be grown in pots until planted. They are also handsome greenhouse shrubs, and grow best in a sandy compost of peat and loam.

Propagation is by seeds and greenwood cuttings in spring; sometimes also by layers and grafting.

A. *Branchlets pubescent or tomentose: lvs. persistent, crowded.*

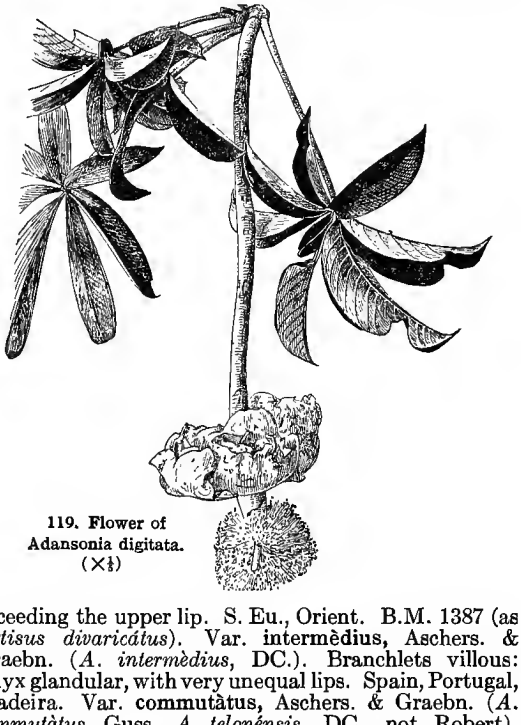
viscòsus, Webb & Berth. (*A. Anagỳrus*, Spreng. *A. frankenioìdes*, Choisy). Branchlets pubescent: lfts. linear-oblong, folded: fls. crowded, in short racemes; calyx glandular, the lateral segm. of the lower lip longer than the middle one, exceeding the upper lip. Teneriffe.

hispánicus, DC. Shrub, about 6 ft. or more: branchlets velvety-pubescent: lfts. lanceolate, acute, tomentose beneath: racemes dense, oblong, many-fld., short-peduncled; calyx pubescent and glandular; segms. very unequal, those of the lower lip nearly equal, but much longer than those of the upper lip. Spain.

decórticans, Boiss. (*A. Boissièri*, Webb). Shrub or small tree, 15–25 ft.: branches tomentose: lfts. linear, pubescent: racemes short, compact; calyx villous, segms. nearly equal. Spain. R.H. 1883:156. G.C. II. 25:725. Gn. 30:498.—Resembles English gorse, but is thornless. Bark peels naturally. Thrives in poor, sandy soil.

AA. *Branchlets soon glabrous: lvs. deciduous.*

complicàtus, Gay (*A. divaricàtus*, Sweet. *A. parvifòlius*, DC.). Much-branched shrub, 1–3 ft.: lvs. deciduous, fascicled; lfts. obovate or oblong-lanceolate, pubescent beneath, often folded: fls. in elongated racemes; calyx pubescent, usually glandular, middle segm. of the lower lip longer than the lateral ones, usually much exceeding the upper lip. S. Eu., Orient. B.M. 1387 (as *Cytisus divaricátus*). Var. **intermèdius,** Aschers. & Graebn. (*A. intermèdius*, DC.). Branchlets villous: calyx glandular, with very unequal lips. Spain, Portugal, Madeira. Var. **commutàtus,** Aschers. & Graebn. (*A. commutàtus*, Guss. *A. telonénsis*, DC., not Robert). Racemes usually short; calyx not glandular, with the lips little differing in length. S. Eu., Orient.



119. Flower of Adansonia digitata. (×⅓)

A. foliolòsus, DC. Branches and lvs. crowded, villous: racemes compact, many fld.; calyx villous. Canary Isls.—*A. grandiflòrus*, Boiss.=A. telonensis.—*A. intermèdius*, DC.=A. complicatus var. intermedius.—*A. parvifòlius*, DC.=A. complicatus, Gay.—*A. telonénsis*, Robert (A. grandiflorus, Boiss.). Branches and lvs. glabrous: racemes few-fld.; calyx pubescent. S. France, Spain.—*A. telonénsis*, DC.=A. commutatus.

ALFRED REHDER.

ADENÓPHORA (*gland-bearing;* referring to the cylindrical nectary which surrounds the base of the style). *Campanulàceæ*. Campanula-like border perennials.

Herbs, differing from Campanula chiefly by the style being surrounded by a cylindrical gland: corolla ball-shaped, 5-lobed: stamens free from corolla, the filaments dilated and ciliate toward base; caps. 3-celled.—About 14 species of hardy herbaceous perennials in Siberia, China and Japan. Fls. blue, nodding, on short pedicels, produced freely in midsummer in slender but stiff, erect panicles or loose racemes.—For cult. see *Campanula*.

Propagation is by seeds or cuttings in spring. The

plants do not take kindly to division or other disturbance of the roots. Many other species than those in the trade are worthy.

commùnis, Fisch. (*A. liliflòra,* Schur. *A. Fischeri,* Don. *A. lilifòlia,* Ledeb.). Radical lvs. petiolate, ovate-rotund, cordate, crenate-dentate; cauline lvs. sessile, ovate-lanceolate, coarsely serrate: fls. numerous, in a pyramidal panicle; lobes of the calyx triangular; style exserted.

Lamárckii, Fisch. Lvs. ovate-lanceolate, sharply serrate, ciliate, otherwise glabrous: fls. racemose; lobes of the calyx lanceolate; style not exserted.

Potanìnii, Hort. Shrubby: spikes 2–3 ft. high; fls. 1¼ in. across, light blue. July, Aug. Intro. 1899.

polymórpha, Ledeb. Three ft: lvs. verticillate, the whorls remote, and small fls. which are darker in color than *A. Potaninii.* Aug. Russia. Var. **strícta,** with more erect habit than the type, seems to be more common.

A. coronopifòlia, Fisch. 1–3 ft.: radical lvs. petiolate, ovate-rotund, cordate, crenately toothed, hairy; upper lvs. sessile, entire or nearly so, glabrous, and linear lanceolate: fls. racemose, 3–10 in a cluster, blue, each fl. on a slender pedicel. June. Dahuria. —*A. denticulàta,* Fisch. (*A. tricuspidata,* DC.). 1½–2 ft.: upper lvs. sessile, ovate-lanceolate, the lower and radical ones petioled and more or less orbicular: fls. small, blue, pedicillate, in a terminal, loose raceme. July. Dahuria.—*A. Gmelìnii,* Fisch. 1–2½ ft.: lvs., or at least the upper ones, linear, narrow, entire or nearly so, and quite glabrous: fls. blue, 3–10 in a second racemose cluster which is axillary near the upper part of the st. Dahuria.—Suitable for dry and stony places.—*A. intermèdia,* Ledeb., not Sweet (A. coronata, DC.). Plant 2–3½ ft.: radical lvs. petiolate, cordate, toothed; upper lvs. acutish at base, serrate, crowded: fls. pale blue, racemose, small. May. Siberia.—*A. periplocæfòlia,* DC. A dwarf (3 in.) perennial suitable for rockeries, with ascending st.: lvs. petiolate, ovate, acute at the apex, slightly cordate at the base, crenately serrate: fls. usually solitary and acapose, pale blue. June. Siberia.—*A. stylòsa,* Fisch. 1–2 ft., erect: lvs. petiolate, the lower obovate and sinuate, the upper ovate, acuminate, quite glabrous: fls. few, racemose, the raceme naked, and lax. May. E. Eu.—*A. verticillàta,* Fisch. 2–3 ft.: st. simple: lvs. whorled, serrate, the upper ovate-lanceolate, the lower petiolate, sub-orbicular: fls. pale blue, small, arranged in irregular clusters near the top of the st., some, along the lower part of the st., in whorls. June. Dahuria.

N. TAYLOR.†

ADENÓSTOMA (*aden,* gland, *stoma,* mouth; calyx with five glands at the mouth). *Rosàceæ.* Ornamental woody plants, cultivated chiefly for their handsome white flowers.

Evergreen, somewhat resinous shrubs, rarely small trees: lvs. linear, small: fls. white, about 1–5 in. broad, in terminal panicles; calyx-tube obconical, with 5 short teeth and 5 glands at the mouth; petals 5, stamens 10–15; pistil 1, with the lateral style strongly curved above the base: fr. a small achene, inclosed in the persistent calyx-tube.—Two species in Calif.

The adenostomas are heath-like evergreen shrubs; very handsome when in full bloom. They may be cult. in temperate regions in a sunny position and well-drained soil. *A. fasciculatum* stands many degrees of frost. Prop. is by seeds and greenwood cuttings in spring.

fasciculàtum, Hook. & Arn. Shrub, 2–20 ft.: lvs. fasciculate, linear, about ¼in. long: panicles rather dense, 2–4 in. long; fls. nearly sessile. May, June. Ranges northward to Sierra Co.—The characteristic shrub of the chaparral or chamisal regions of the coast ranges of Calif. Hooker & Arnott, Bot. Beechey's Voy. 30. Intro. 1891.

sparsifòlium, Torr. Shrub or small tree, 6–12 ft., rarely 30 ft., resinous: lvs. alternate: panicles loose; fls. pedicelled, larger, ⅙in. across, fragrant. S. and Low. Calif. Emory Rep. U. S. and Mex. Bound. Surv. 20. Intro. 1891.

ALFRED REHDER.

ADENÓSTYLES (from *aden,* a gland, and *stylus,* a style, in allusion to warty glands of the stigmas). *Compósitæ.* A little-known group of hardy perennials, grown for their purplish or whitish flowers, perhaps known in America only in botanic gardens.

Leaves alternate or radical, usually broad, the petiole frequently dilated into a stipule-like, st.-clasping base; fls. in medium-sized heads, the fls. all tubular, long, exserted; involucre cylindric or bell-shaped, its bracts small and unequal.—There are only 5 species, all natives of Cent. S. Eu. None is of horticultural importance. May be grown in the open border. Prop. is by seed and division.

álbifrons, Reichb. A much-branched, hairy perennial, 2–3 ft.: lvs. on the lower surface cottony, bright green above, almost round and deeply cordate; basal lvs. long-stalked; the stalks eared: heads 15–20-fld., purple, rather attractively paniculate or corymbose. Woody mts., S. Eu. July, Aug.

A. alpina, Bluff. & Fingeruth. A lower, smooth perennial, with the heads 3–6-fld.; is scarcely known in Amer. It is not so showy as A. albifrons. S. Eu.

N. TAYLOR.

ADÉSMIA (*not bound;* referring to the free stamens). *Leguminòsæ.* More than 100 species of tender herbs, shrubs or sub-shrubs from S. Amer., allied to the peanut. Lvs. abruptly pinnate, ending in a bristle: fls. axillary, solitary, or sometimes racemose and terminal. Some of them are showy.

A. balsámica, Bert. Lvs. 1–1½ in. long; lfts. 10–16 in pairs: racemes 3–8-fld.; fls. ⅔in. across, golden yellow. Chile. B.M. 6921.—Has the odor of balsam.—*A. boronioides,* Hook. A pretty shrub, warted all over, except the petals and lfts., with large balsamiferous glands: lvs. 1½–2 in. long, made up of from 10–13 pairs of sessile, orbicular, coarsely crenate, dark green lfts.: fls. bright orange-yellow, in terminal racemes. Patagonia. B.M. 7748. —*A. glutinòsa,* Hook. & Arn. 2 ft., shrubby; the branches clothed with glutinous hairs: lvs. with 3–4 pairs of hairy elliptic lfts.: fls. yellow, racemose and terminal. Chile.—Neither is in the American trade, but both cult. in botanic gardens.

N. TAYLOR.†

ADHÁTODA (native name). *Acanthàceæ.* About 25 species of tender shrubs, distinguished from Justicia by the less-spurred anthers, and often by the habit and calyx, but considered by de Dalla Torre and Harms as a mere section of that genus. Fls. whitish or purplish; calyx 5-cleft, often exceeded by the bracts; corolla long-tubed, the limb prominently 2-lipped; stamens 2. For culture, see *Justicia.*

cydoniæfòlia, Nees. BRAZILIAN BOWER-PLANT. Lvs. opposite on short petioles, ovate: lower lip broadly obovate, purple. Brazil. B.M. 4962. F.S. 12:1222. R.H. 1873:110.—Cult. in Calif.

A. Vásica, Nees. Lvs. ovate-lanceolate, acuminate: fls. white, streaked red or purple. Ceylon. B.M. 861 (as *Justicia Adhatoda*).

N. TAYLOR.†

ADIANTÓPSIS (Greek, *like Adiantum*). *Polypodiàceæ.* Like Adiantum, but differing in having the sori simple, one to each veinlet and not occupying the ends of several veinlets, as in Adiantum.—A small genus, little known in cult.

pedàta, Moore (*Cheilánthes pedàta,* R. Br.). Lvs. cespitose, on long (9–12 in.) sts., about 6 in. either way, the 3 divisions bipinnatifid; sori numerous, placed on both sides of the segm. Jamaica, Cuba.

R. C. BENEDICT.

ADIÁNTUM (Greek, *unwetted*). *Polypodiàceæ.* MAIDENHAIR FERN. A large, widely distributed genus of ferns, mainly of tropical countries, some of them popular greenhouse and conservatory plants.

The leaves have usually polished black or purplish stalks, the blades thin and delicate, simple or divided into usually fan-shaped segments, with the outer margins revolute, covering linear sori. Of the one hundred or more species, only one, *A. pedatum,* occurs, commonly in temperate North America. A few others are found in the southwestern states and in Florida. *A. cuneatum* is the most frequently cultivated of the exotic species.

The genus Adiantum furnishes some of the most useful and popular species of commercial ferns. They are easy of cult. They need a slightly shaded position, moderately moist atmosphere, and a temp. of 60–

65° F. The soil should be composed of rich loam and leaf-mold in equal parts, and should be kept moderately moist. Some of the most useful ones for general purposes (given under their trade names) are: *A. æmulum*, grows about 12–15 in. high, and has very graceful dark green fronds; *A. bellum*, a dwarf, very compact species, 6–8 in.; *A. cuneatum*, *A. cuneatum* var. *grandiceps*, with long, heavily crested, drooping fronds; *A. cuneatum* var. *variegatum* making a neat specimen; *A. concinnum*, gracefully drooping dark green fronds 15 in. long, with overlapping pinnæ; *A. concinnum* var. *lætum*, of upright growth, is 24 in. high; *A. decorum* very useful, 12–15. in., and has young fronds of a pleasing metallic tint; *A. excisum* var. *multifidum; A. formosum; A. Fergusonii; A. fragrantissimum; A. pubescens; A. tenerum* and var. *roseum; A. Wiegandii; A. LeGrandii*, very dwarf; *A. mundulum*, a very neat, dwarf species; *A. rubellum*, a dwarf species with mature fronds light green, young fronds of a deep ruby tint. The above may easily be grown from spores, if sown on a compost consisting of half each of finely screened clean soil and leaf-mold or peat, and placed in a moderately moist and shady place in the greenhouse in a temp. of 60° F. To be grown most economically, they should be transplanted in clumps of 3 or 4 plants as soon as the first pinnæ have appeared, and, as soon as strong enough, potted off, either in clumps or singly. Some very desirable species to grow into large, tall specimens are: *A. æthiopicum*, *A. Bausei*, *A. Collisii*, *A. Fergusonii*, *A. formosum*, *A. Lathomii*, *A. peruvianum*, *A. princeps*, *A. rhomboideum*, *A. Sanctæ-Catharinæ*, *A. trapeziforme*, and *A. Williamsii*. The following are also recommended for special purposes: for fern-dishes, *A. fulvum;* for cutting, *A. gracillimum*. The following kinds are economically prop. by division, temp. 65° F.: *A. Farleyense*, the different varieties of *A. Capillus-Veneris*, *A. rhodophyllum*, *A. assimile*. Some kinds, as *A. dolabriforme*, *A. caudatum* and *A. Edgeworthii*, form small plants on the ends of fronds, which may be detached and potted separately, and if kept in a close atmosphere will in a short time grow into choice little plants. Temp. 65–70° F. (Nichol N. Bruckner.)

The following directions (mostly for commercial growing) are prepared for this entry by James C. Clark:

Adiantums, when grown in large quantities, are best propagated from spores sown in pots or pans, 6-inch being a good size, pots being preferred to pans as they maintain a more constant and equal moisture. The pots should be filled with two-thirds good drainage (coal-ashes or potsherds are very suitable), top-dressed with one-third sterilized loam mixed with one-tenth part of sharp sand finely sifted and evenly pressed down in the pot, so that the top of the soil will be about ¼ inch below the rim. The pots should then be placed on a greenhouse bench, under shaded glass, and where a temperature of 65° to 70° can be maintained. Then water until they are thoroughly soaked (and to make sure that they are wet, water again; it is impossible to make too wet). Allow to drain for an hour or so and then dust the spores evenly, and as thinly as possible, over the surface and cover immediately with glass. The glass should remain on, and no water should be required or given, unless by dipping, until the spores have developed to the prothallus stage, when it will be advantageous to give a slight watering, using a very fine rose, and raise the glass 8 inches above the pots, supporting so that a free current of air can pass directly over the pots.

At this stage of their development, adiantums, like all other fern prothalluses, must never be allowed to become dry. At the same time, great care must be exercised so that there will be sufficient air to prevent damping and yet no direct draft either from the heating pipes or ventilators to cause wilting or drying out of the pots.

As soon as the first real fronds appear (generally in eight to twelve weeks from time of sowing, according to season of year; eight weeks in spring and summer; twelve weeks in fall or winter), the seedlings should be transplanted in small clumps of three to five seedlings each, into flats or seed-pans, spaced about 1 inch apart, and placed in a close warmhouse, in a night temperature of 65° to 70°, until the seedlings show signs of taking root and making new fronds, when the temperature may be lowered to 60° at night and 65° to 70° in the day. This temperature will be found to suit all adiantums (except *A. Farleyense*), in all stages of their future development.

When the transplanted seedlings are about 1 inch high, they may be placed in small pots and repotted into larger ones as soon as they require it. In potting, a good compost consists of nine parts of loam and one part of well-rotted cow-manure, the pots being provided with good drainage, especially the larger sizes. In potting, the crown of the plant should be placed deep enough so that it will be covered with ¼ to ¾ inch of fresh soil, making the soil only moderately firm (never hard). Place the plants in a greenhouse, spaced so that there will be a free circulation of air all around the plants, the glass moderately shaded from March 15 to November 1, and all shade removed during the winter months, giving as much ventilation (without draft) as possible. The soil should be kept moderately moist at all times and a good atmospheric moisture maintained by wetting down the walks, but at no time should the foliage be wet more than possible. Well-drained, solid beds are better adapted to the growth of adiantums than tables, but, if grown on the latter, a ½-inch overhead heating-pipe over each table, say 18 inches above the foliage, will be found of great assistance in overcoming the condensation that is so destructive to the foliage when the plants are grown on tables.

Treated as above, adiantums can be grown into 6-inch pot specimens in one year from time of sowing spores, and when grown rapidly are seldom troubled with insect pests, unless it be green-fly, which can be kept under control by a weekly application of nikoteen, using two ounces to five gallons of water, applied in as fine spray as possible.

Specimen adiantums, in 8-inch pots or larger, can be grown in the same-sized pots for several years, provided they are slightly rested during the winter months by being kept on the dry side and in a lower temperature, say 45° to 55°. In February the plants should be removed from the pots, the drainage examined, a little of the top-soil removed, and then top-dressed with old rotted cow-manure, and the plants returned to a growing temperature and given more water as required. Feed either with liquid manure or dust with pulverized animal manure every second week during the growing season. Some of the finest specimen adiantums in this country have been grown in the same-size pots for five to seven years.

Scale sometimes attacks old specimen adiantums, and there is only one remedy,—rest the plants by keeping to the dry side and in a cool temperature for about a month; then cut off all the fronds clear down to the crowns, and treat the same as old specimen plants.

For amateurs and small growers, all adiantums can be propagated by division of the crown and rhizomes. This is best done in January and February. Wash off all soil and cut the roots off as close to the crowns as possible. Then divide to single eyes. Place the eyes in sharp sand, merely covering them. Place in a situation such as advised for spores and cover with glass; when the first fronds appear, treat exactly the same as recommended for seedlings, when they will make plants about as quickly and equally as good as those grown from spores.

Adiantum Farleyense, being a sterile species, must be propagated by division. It requires the treatment recom-

mended for adiantums in general with the exception of a much higher temperature, 65° to 70° at night and 75° to 80° during the day. The variety Glory of Moordrecht has the great advantage of producing fertile spores and it also thrives in the lower temperatures recommended for general adiantums. It gives promise of being one of the most useful varieties for decorations and cut-fronds use, as the fronds are very much hardier than typical *A. Farleyense* and will compare well with such kinds for standing as *A. cuneatum, A. hybridum* and *A. Croweanum.*

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A. *Lvs. with a single row of small lfts. on either side, rooting at the apex.*

1. **lunulàtum,** Burm. (*A. dolabriförme*, Hook.). Lvs. 1 ft. long on blackish, wiry, polished stalks; lower lfts. nearly semicircular, all on hair-like stalks. India, Trop. Amer., Austral. G. 6:203.

2. **caudàtum,** Linn. (*A. Edgeworthii*, Hook.). Lvs. 6–12 in. long, on short, brownish, densely hairy stalks; lfts. deeply cut into several spreading narrow lobes. Old World. Gn. 68, p. 315.

AA. *Lvs. with usually a single row of large lfts. on either side, not rooting at the apex.*

3. **peruviànum,** Klotzsch. Lvs. 1 ft. or more long, on polished stipes, with obliquely ovate pointed lfts. 2 in. long by 1½ in. wide, on slender stalks; sori 8–10 on either side of the lfts., twice as long as wide. Peru.

4. **macrophýllum,** Swartz. Lvs. 1 ft. long, on rather stout polished stipes, with 4–6 pairs of wedge-shaped sessile lfts. 1½–2 in. long by ¾–1 in. wide; indusium nearly continuous on either side of the lft. Trop. Amer.

5. **Kaúlfussii,** Kunze. Lvs. 6–8 in. long, on slender black stalks; lfts. 5–11, 2 in. long, ¾–1 in. wide, with unequal base; indusia very long and narrow, forming an almost continuous marginal band on either side of the lfts. Mex., W. Indies.

6. **platyphýllum,** Swartz. Lvs. 1–2 ft. long, stalks black, glossy, lf.-blades 6–12 in. long, 2–4 in. broad, with a long terminal pinna and 3–6 pairs of lateral pinnæ; lowest pinnæ sometimes pinnately divided; segm. 3–4 in. long, 1½–2 in. broad; sporangia in nearly continuous line along the margin. Cent. Amer. to Brazil and Bolivia.

AAA. *Lvs. at least bipinnate, the segms. twice as long as broad, with the veinlets all springing from the lower side.*

B. *Lfts. 1½–2 in. long.*

7. **trapezifórme,** Linn. Lvs. 18 in. or more long, with the terminal lft. longer than the lateral; lfts. trapezoidal, ½–¾in. wide, lobed, and with numerous sori. *A. Sánctæ-Catharìnæ* is a form with deeper lobes. Trop. Amer.

BB. *Lfts. smaller, an inch or less long.*

C. *Stalks polished, smooth.*

8. **polyphýllum,** Willd. Lvs. often tripinnate, with stout black stalks; pinnæ 6–8, long, with closely set lfts. which are ¾–1 in. long, the upper margin curved, with 4–6 circular or oblong indusia. S. Amer.

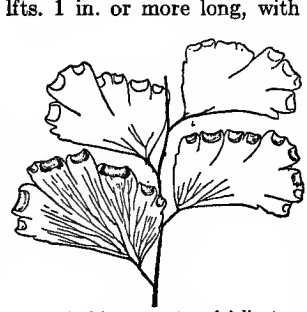
9. **diáphanum,** Blume (*A. setulòsum*, J. Smith). Lvs. simply pinnate or usually 2-pinnate at the base; lfts. ½in. long, ¼in. wide, with numerous sori placed in the sinuses of the inner and outer edges. Asia to New Zeal.

10. **affìne,** Willd. Lvs. bipinnate, with a terminal pinna and several lateral ones; lfts. not exceeding ¾in. long, ¼in. wide, the upper edge parallel with the lower, and crenate, bearing numerous rounded sori on the upper and outer margin. New Zeal.

11. **fùlvum,** Raoul. Lvs. 15–20 in. long, the stalks erect, dark brown, shiny, rough below with long hairs; the lf.-blades 9–12 in. long, 6–8 in. broad, deltoid, 2-pinnate, the segm. ¾in. long, ¼in. broad, dimidiate, lower edge straight, the upper edge parallel with sharp-tooth lobes; the sori uniform, numerous. New Zeal.

CC. *Stalks polished but somewhat woolly.*

12. **intermèdium,** Swartz. Lvs. 1 ft. or more long, with a terminal pinna and 1–3 lateral ones on each side; lfts. 1 in. or more long, with interrupted sori on the upper and two-thirds of the outer margins. Trop. Amer.



120. Fruiting pinnules of Adiantum pedatum. (×1)

CCC. *Stalks rough or hairy.*

13. **formòsum,** R. Br. Lvs. 1–2 ft. long, two-thirds as broad, mostly tripinnate, with rough, scabrous stalks and rather small, deeply lobed lfts. ½–¾ in. long, with rounded and toothed outer margins. Austral. G. 20:769.

14. **pulverulèntum,** Linn. Lvs. often a foot long, with a large terminal pinna and several lateral ones, bipinnate; stalks purplish, hairy, as are also the rachises; lfts. ¾–1 in. long, ¼in. wide, closely placed, the outer edge rounded or truncate. W. Indies.

15. **villòsum,** Linn. (*A. rhomboìdeum*, Swartz). Lvs. large, with a terminal and several lateral pinnæ 6–12 in. long, on stout, villous-hairy stalks; lfts. numerous, nearly 1 in. long, ⅛in. wide, trapezoidal, with the inner side parallel to the rachis; indusia forming an almost continuous line along the upper and outer margins. W. Indies and S. Amer.

16. **nòvæ-caledòniæ,** Keys. Lvs. 6–8 in. long and wide, somewhat pentagonal, once pinnate with one or two secondary basal pinnæ on the lower side at base; lfts. attached to the rachises by a broad base, nearly 1 in. long, pointed, irregularly incised, bearing 1–4 rounded sori next to the base. New Caledonia.

AAAA. *Lvs. forked, the two branches bearing pinnæ from the upper side.*

B. *Stalks polished, smooth.*

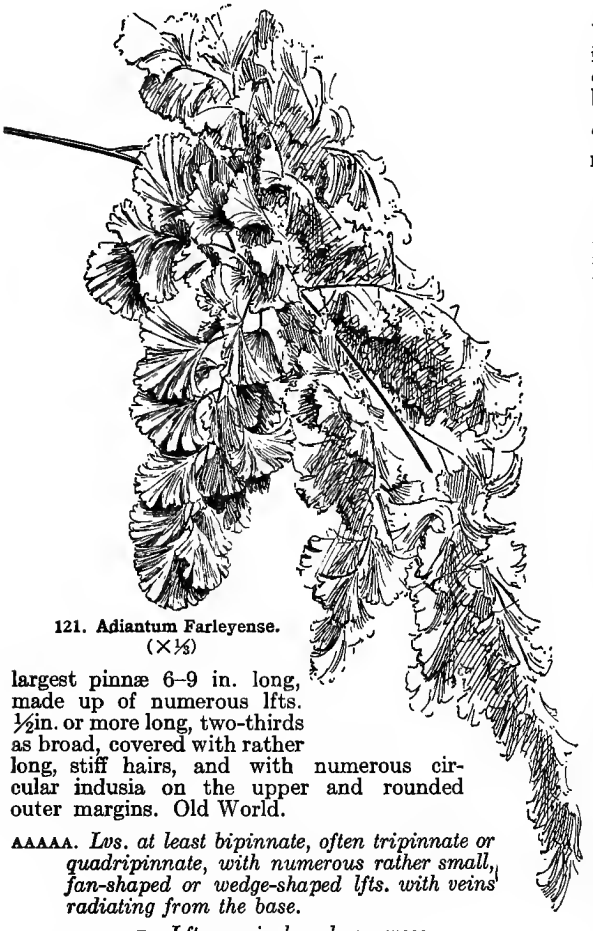
17. **pedàtum,** Linn. Fig. 120. COMMON MAIDENHAIR of our northern states, with circular lvs. on purplish stalks 1 ft. or more high.—Sometimes transplanted into gardens, requiring a shady, moist and protected place. G. 21:9.

18. **curvàtum,** Kaulf. Lvs. forked and with the main divisions once or twice forked; lfts. 1–1½ in. long,

nearly ½in. wide, the upper margin rounded and lobed. Brazil.

BB. *Stalks scabrous (or rough).*

19. **hispídulum,** Swartz (*A. pubéscens,* Schk.). Lvs. forked, two divisions branching like a fan, with the



121. Adiantum Farleyense. (×⅓)

largest pinnæ 6–9 in. long, made up of numerous lfts. ½in. or more long, two-thirds as broad, covered with rather long, stiff hairs, and with numerous circular indusia on the upper and rounded outer margins. Old World.

AAAAA. *Lvs. at least bipinnate, often tripinnate or quadripinnate, with numerous rather small, fan-shaped or wedge-shaped lfts. with veins radiating from the base.*

B. *Lfts. an inch or less across.*

C. *Edges deeply cut into a series of narrow lobes.*

20. **Farleyénse,** Moore. Fig. 121. Lvs. often reaching 15–24 in. in length, forming a rich profusion of closely overlapping pinnæ, light green; lfts. more or less wedge-shaped at base, with curved sides and the outer margin rounded and deeply cut into 10–15 narrow lobes, which rarely bear sori. Barbadoes.—Said to be a garden variety of *A. tenerum,* but apparently a good species. G.C. III. 49:73.

CC. *Edges not laciniately cut.*

21. **ténerum,** Swartz. Lvs. deltoid, 12–24 in. long, two-thirds as wide, the terminal lfts. equally, the lateral unequally, wedge-shaped at base, all of them rhombic and deciduous when dry, with 10 or less small sori on the outer and inner margins. *A. Làthomii, A. Victòriæ, A. rhodophýllum, A. princeps, A. acutum,* and *A. Bausei* are horticultural forms. Fla. and Trop. Amer.

22. **Jórdanii,** C. Muell. (*A. emarginàtum,* D. C. Eaton, not Hook.). Lvs. 1 ft. or more long, 6 in. wide, mostly twice pinnate, with nearly semicircular lfts.; sori elongate, the indusium almost continuous around the margin of the lft. Calif. and Ore.

23. **Williamsii,** Moore. Lvs. triangular, nearly 1 ft. long; lfts. nearly semicircular, 3–4-lobed on the outer margin, bearing 5–8 sori covered with oblong indusia. Peru.—Similar in habit to the last, but smaller and with more numerous sori.

BB. *Lfts. mostly less than a half inch across.*

C. *Lvs. at least quadripinnate, broader than long.*

24. **Cóllisii,** Moore. Lvs. 1 ft. or more long, very broad, the black rachises apparently repeatedly forking; lfts. rhombic-ovate or cuneate, those toward the outer portions longer and larger than those nearer the base.—Of garden origin, possibly a hybrid.

CC. *Lvs. mostly triangular or oblong, longer than broad.*

D. *Shape of lfts. rhombic, the indusia kidney-shaped or nearly circular.*

25. **concínnum,** HBK. Fig. 122. Lvs. 2–3 pinnate, 12–18 in. long, 6–9 in. wide, on rather stout black stalks; lfts. rhombic-oblong, slightly lobed; sori 4–8 on each lft., usually set close together. Mex. to Brazil. Var. **làtum,** Moore. Differs from type by stiff upright habit, and lfts. twice as large and much separated.

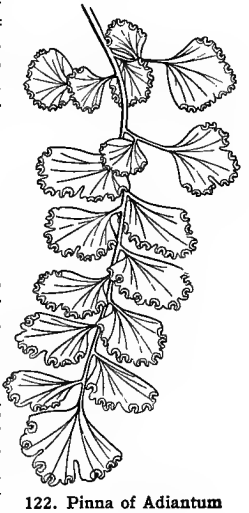
26. **aneiténse,** Carr. Rootstock wide-creeping, covered with minute dark brown linear scales; lvs. 2–2½ ft. long, the stalks castaneous, rusty hairy above; the lf.-blades deltoid, 1½–2 ft. long and broad, 3–4-pinnate, the segm. rhomboidal, the sori 4–6 to a segm. Aneiteum, New Hebrides.

27. **tínctum,** Moore. Lvs. on stalks 4–6 in. long, the blades 2-pinnate, deltoid, the stalks black, glossy, naked, the segms. rhomboid, 3–4 lines long, the lower edge straight, the inner parallel to the rachis or just overlapping it, the outer edge bluntly lobed, sori round, on ultimate lobes. Costa Rica to Peru.

DD. *Shape of lfts. roundish with obtuse base, small or medium size.*

28. **æthiòpicum,** Linn. (*A. assímile,* Swartz). Lvs. 1 ft. or more long on slender stalks, 2–3-pinnate, rather narrow; lfts. roundish or obscurely 3-lobed, the margin finely serrulate; sori 2–3 to a lft., with oblong or kidney-shaped indusia. Afr. and Austral.

29. **excìsum,** Kunze. Lvs. 2–3-pinnate, 6–12 in. long, 3–4 in. wide; lfts. about ¼in. wide, roundish, with the margin cut into small rounded lobes; sori large, 2–4 to each lft.; kidney-shaped or circular. Chile.



122. Pinna of Adiantum concinnum. (×⅔)

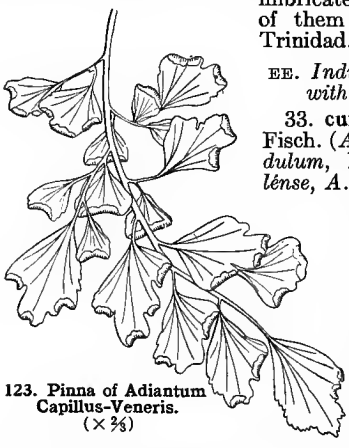
DDD. *Shape of lfts. distinctly cuneate at the base.*

E. *Indusia oblong or indistinctly lunate.*

30. **Capíllus-Véneris,** Linn. (*A. Férgusonii, A. Mairísii,* Moore). Fig. 123. Lvs. 2–3-pinnate, 6–20 in. long, 3–8 in. wide; lfts. nearly ½in. wide, more or less irregularly lobed, at the outer margin; sori 1–3 to each lft. with oblong or more or less elongate narrow indusia. Native southward, and widely distributed throughout the Old World.—Exists in many varieties, some of them deeply lobed, like *A. Farleyense;* a compact imbricated form is very effective.

31. **béllum,** Moore. Small, tufted, 3–8 in. high: lvs. bipinnate; lfts. with the outer margin erose and often divided into 2–3 shallow lobes; sori 2–3 to each lft., rather long and broad or somewhat lunate. Bermuda. —A greenhouse species.

32. **Bessóniæ,** Jenman. Lvs. 11–16 in. long, the stalks in tufts, stiff, black, shiny, with a few pale scales; lf.-blades deltoid, 4-pinnate, the pinnulæ very densely imbricated so that many of them are covered over. Trinidad.



123. Pinna of Adiantum Capillus-Veneris. (×⅔)

EE. *Indusia nearly circular, with a narrow sinus.*

33. **cuneàtum,** Langs. & Fisch. (*A. æmulum, A. múndulum,* Moore. *A. versaillénse, A. fragrantíssimum, A. hýbridum,* Hort.). Fig. 124. Lvs. 3–4-pinnate, deltoid, 6–15 in. long, 5–9 in. wide; lfts. numerous, obtuse or broadly wedge-shaped at base, the margin rounded and more or less crenately lobed; sori 3–5 to each segm., with rather small rounded indusia. Brazil.—Runs into many forms, of which *A. variegàtum* is one. A.F. 18:508. *A. Bárdii* differs from the type in having the fronds 2 ft. or more long. Var. **grandíceps,** Moore. Robust: lvs. numerous from a tufted crown, elongated, with tassel-like growths at the ends. Var. **Croweànum,** Hort. A vigorous hardy form.

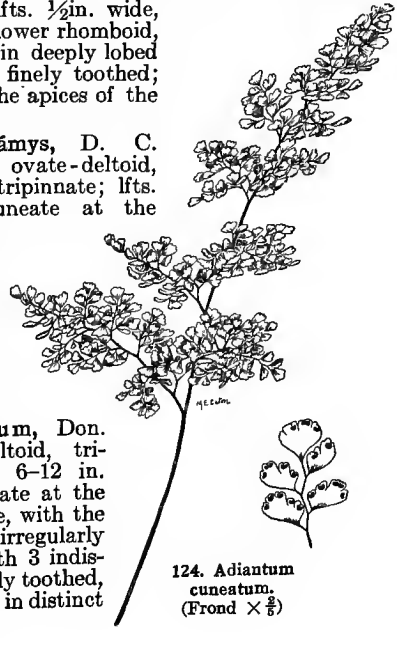
34. **Moõrei,** Baker (*A. amábile,* Moore, not Liebm.). Lvs. 2–3-pinnate on long, slender stalks, 6–15 in. long; lfts. ¼–½in. long, rhomboidal, with wedge-like base, deeply lobed; sori of medium size, 4–6 to each lft. Peru.

35. **Wágneri,** Mett. (*A. décorum, A. Wiègandii, A. élegans, A. Owenii, A. cyclosòrum,* Moore). Lvs. 2–3-pinnate, 6–9 in. long, 4–6 in. wide; lateral lfts. rhomboid, the terminal cuneate, slightly lobed or incised; sori 4–6 to each lft.; very large membranous circular indusia. Peru. —*A. Siebrechtii,* Hort., "supposed to be a cross between *A. decorum* and *A. Williamsii,*" has strong, graceful lvs. thickly set with round pinnules of firm texture.

36. **rubéllum,** Moore. Lvs. 4–6 in. long, deltoid, bipinnate; texture membranous, bright green, reddish when young; lfts. ½in. wide, deltoid or the lower rhomboid, the outer margin deeply lobed and the lobes finely toothed; sori round at the apices of the lobes. Bolivia.

37. **monochlámys,** D. C. Eaton. Lvs. ovate-deltoid, 6–12 in. long, tripinnate; lfts. ¼in. wide, cuneate at the base, the upper edge rounded, and slightly toothed, with a single sorus or rarely two in a decided hollow at the upper edge. Japan.

38. **venûstum,** Don. Lvs. ovate-deltoid, triquadri-pinnate, 6–12 in. long; lfts. cuneate at the base, ¼in. wide, with the upper edge irregularly rounded or with 3 indistinct lobes, finely toothed, bearing 1–3 sori in distinct hollows. India.



124. Adiantum cuneatum. (Frond × ⅖)

BBB. *Lfts. minute, innumerable; lvs. 4–6-pinnate.*

39. **gracíllimum,** Moore (of horticultural origin). Lvs. 1 ft. or more long, nearly as wide, 4–6-pinnate, with innumerable very small lfts., which are ⅛–¼in. wide and usually bear a single sorus or rarely two.—Dense, compact forms are in cult. under the name of *A. Le-Grándii.*

AAAAAA. *Lvs. 3–4-pinnate: st. climbing, several ft. long.*

40. **digitàtum,** Presl (*A. speciòsum,* Hook. *A. palmàtum,* Moore). Lvs. 2–3 ft. long on a stalk 18 in. or more long, with palmately lobed lfts. 1 in. or more wide. S. Amer.

A. gròssum, Mett. Stove: lvs. lanceolate, to 1½ ft. and 4 in. broad, once-pinnate, leathery. Colombia. G.C.III. 45:51.—*A. rò-seum,* Backh., an undetermined horticultural name, probably referable to A. rubellum.—*A. scùtum ramòsum,* Hort. A distinct form with fan-shaped lvs. (properly A. Ghieshreghtü, Moore).

L. M. Underwood.
R. C. Benedict.†

ADLÙMIA (from John Adlum). *Fumariàceæ.* A hardy biennial vine, which climbs over high bushes in moist woods: fls. with the petals united into cordate-ovate corolla which ultimately encloses the small, few-seeded pod.—Sow seed in spring in a damp, cool place. Transplant in fall, if possible, if transplanted at all. It does not flower the first season but remains low and bushy. It will not tolerate open sun or windy situation.

125. Adlumia fungosa.

fungòsa, Greene (*A. cirrhòsa,* Raf.). Climbing Fumitory. Mountain Fringe. Allegheny Vine. Figs. 125, 126. Climbs by the slender young lf.-stalks. Lvs. thrice pinnate; lfts. cut-lobed, delicate: fls. white or purplish, in ample panicles. G.W.F. 13. V. 2:76 and 4:22 (all as *A. cirrhosa*). N. Taylor.†

ADODÉNDRUM: *Rhododendron.*

ADÒNIS (a favorite of Venus, after his death changed into a flower). *Ranunculàceæ.* Hardy annual and perennial herbs planted for their showy flowers.

Flowers solitary, terminal; petals 5–16, yellow or red; carpels many: st. about 1 ft. high, very leafy: lvs. alternate, cut into very narrow divisions: fr. an achene.

The culture is simple in any good soil, light moist earth preferred. They thrive in full sun or partial shade; the perennial species well suited for rockwork and borders. Only a few well-known species, natives of temperate regions of Europe and Asia; perhaps 20 in the genus.

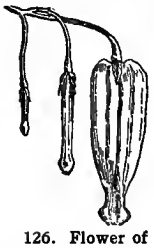
Annuals are propagated by the seeds, which are slow-germinating; the freshest seed is sown in autumn or earliest spring. Perennials may, in like manner, be grown from seed and come to flower the first season,

but division of the roots is to be preferred as the flowers are then more abundant. Very early spring is the best time for dividing.

A. *Annuals: fls. crimson or scarlet.*

B. *St. simple except at top: center of fl. yellow.*

æstivàlis, Linn. PHEASANT'S-EYE. SUMMER ADONIS. Sts. erect, often branched at top: fls. crimson; petals flat, obtuse, half longer than calyx. June, July. Var. **citrìna,** Hoffm., is a garden variety with citron-yellow fls.



126. Flower of Adlumia fungosa. (×¾)

parviflòra, Fisch. Allied to above; not well recognized as a distinct species. Differs in being smaller-fld. and less showy.

microcárpa, DC. Apparently a pale-fld. variation of *A. æstivalis.*

BB. *St. branched: center of fl. dark.*

autumnàlis, Linn. FLOS ADONIS. AUTUMN ADONIS. St. branched: fls. small, crimson, with dark center, globose; petals 6–8, concave, slightly larger than calyx. June–Sept. Gn. 12, p. 131.—Sparingly naturalized.

AA. *Perennials: fls. yellow.*

B. *St. not branched.*

vernàlis, Linn. (*A. apennìna,* Jacq. *A. davùrica,* Reichb.). SPRING ADONIS. Fig. 127. St. simple; lower lvs. scale-like, others with lobes numerous, entire: fls. large; petals 10–15, lanceolate, slightly toothed; sepals smooth. Early spring. Gn. 5, p. 519; 39:268. Gn.W. 23:153. G. 29:146; 9:122; 1:249. Var **álba,** Hort. A form with white fls. J.H. 52:39 (desc.). *A. distórta,* Tenore, from Italy; a form with later fls.

apennìna, Linn. (*A. vernàlis* var. *sibírica.* DC. *A. sibírica,* Patrin.). This species is much like *A. vernalis:* fls. larger: lower lvs. sheath-like. April. Siberia.

BB. *St. branched.*

pyrenàica, DC. St. branched: petals 8–10, obtuse, smaller than in *A. vernalis:* lower lvs. with long branched petioles; upper ones sessile, the numerous lobes always entire. July. Gn. 39, p. 269. Gn.W. 5:533. **A. Ircutiàna,** DC., a form with some radical lvs.; lobes dentate.

volgénsis, Stev. (*A. wolgénsis,* Hort.). Much like *A. vernalis,* but st. branched: lvs. scale-like at base, petioled or sessile above: fls. like *A. pyrenaica,* but sepals pubescent on under side. April. Volga region.

amurénsis, Regel & Radde. A beautiful species, with broad yellow fls.; not much cult. in Amer.; has many Japanese varieties. B.M. 7490. G.M. 40:169; 48:212. Gn. 52:6; 67, p. 207; G.C. III. 29:175 and III. 37:188; J.H. III. 50:299 (fl. pl.). K. C. DAVIS.

ADÓXA (Greek, *without glory,* i.e., *humble* or *obscure*). *Adoxàceæ,* but by some authorities placed in *Caprifoliaceæ* and formerly in *Araliaceæ.* **A. Moschatéllina,** Linn., the Moschatel, is the only species. It is an inconspicuous herb 3–5 in. high, bearing tubers beneath the ground, with biternate lvs., and small greenish fls. It occurs in England, Cent. Eu., and northward, and in subalpine and arctic regions in N. Amer. It is scarcely cult. but may occur in rock-gardens, being grown for its musky scent.

ÆCHMÈA (from *aichme,* point; referring to the rigid points on the calyx). *Bromeliàceæ.* Epiphytic herbs, of about sixty species, natives of tropical South America, grown in choice greenhouse collections.

Flower-cluster arising from a cluster or rosette of long, hard lvs. which are serrate; petals 3, tongue-shaped, obtuse or pointed, 2–3 times the length of the spine-pointed calyx-lobes; stamens 6, shorter than the petals; ovary inferior, 3-celled. The fls. are subtended by (in the axils of) fl.-bracts; the entire head or fl.-cluster is often reinforced or subtended by conspicuous lf.-bracts; in the compound-infl. types, the individual branches are usually subtended by branch-bracts. In some species, as *Æ. Lalindei* and *Æ. Mariæ-Reginæ,* the large colored lf.-bracts are the most conspicuous part of the plant. In others, as *Æ. Veitchii,* the entire head is the showy part. Monogr. by Baker, Journ. Bot. 1879:129, 161, 226. Includes *Canistrum, Echinostachys, Hohenbergia, Hoplophytum, Lamprococcus, Pironneava, Pothuava;* and some of the species have been referred to *Billbergia, Cryptanthus, Guzmannia, Tillandsia, Chevaliera,* and others.

The æchmeas are closely allied to the billbergias, from which they are distinguished by smaller flowers, which are little exserted from the calyx and not widely expanding, short filaments and small anthers, sharp-pointed sepals and conspicuous sharp-pointed flower-bracts.

For culture, see *Billbergia.*

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distichantha, 1.	Lindenii, 5.	Weilbachii, 9.

A. *Fls. 2-ranked on the branchlets.*

1. **distichántha,** Lem. Lvs. 2–3 ft. long, with a dilated base 4–5 in. long and half as wide, the blade rigid and channelled, edges prickly: scape 1–1½ ft.; fls. in a bipinnate panicle 4–7 in. long and half as wide, the petals tongue-shaped and red-purple, longer than the obtuse-cuspidate sepals; fl.-bract pocket-like, ¼in. long. Brazil. B.M. 5447. J.F. 3:269.

AA. *Fls. multifarious,—in several or many rows on the spike or branchlets.*

B. *Infl. simple.*

C. *Ovary compressed or flattened.*

2. **Lalíndei,** Lind. & Rod. Large (3–4 ft.), with long and broad spine-edged lvs.: spike very dense, greenish white, from the color of the aggregated calices, the fls. subtended by many deflexed, showy red, long-pointed, entire bract-lvs.; corolla green, not exserted. Colombia. I.H. 30:481.—Striking.

3. **Mariæ-Reginæ,** Wendl. Smaller than the last in all its parts: petals blue-tipped when young, fading to crimson like the bracts, half as long again as the mealy cuspidate sepals; fl.-bracts entire, small, not showy: bract-lvs. toothed. Costa Rica. B.M. 6441. Gt. 49:1477.—One of the best species.

4. **Veìtchii,** Baker. Lvs. spotted, serrate: petals pale, a little longer than the sepals; fl.-bracts con-

127. Adonis vernalis. (×½)

spicuous, toothed, scarlet: bract-lvs. greenish, erect, serrate, not encompassing the infl. S. Amer. B.M. 6329. G.Z. 23, pl. 30.—Referred to Ananas by Bentham & Hooker.

CC. *Ovary terete (cylindrical).*

D. *Head oblong.*

5. **Líndenii,** Koch (*Hoplophỳtum Líndenii*, Morr.). Lvs. dilated and entire at base, the blade minutely toothed and 2–3 ft. long, the tip broad-rounded and short-cuspidate: petals lemon-yellow, twice as long as sepals. Brazil. B.M. 6565.

DD. *Head globose.*

6. **calyculàta,** Baker (*Hoplophỳtum calyculàtum*, Morr.). Lvs. about 1 ft. long, with an oblong, dilated base, the blade minutely toothed and rounded at the tip, but terminated with a minute cusp: scape shorter than the lvs., with several deciduous lanceolate bract-lvs.; petals tongue-shaped, not ½in. long, bright yellow; fl.-bracts small, entire, reddish. S. Amer.

7. **fasciàta,** Baker (*Billbérgia fasciàta*, Lindl. *B. rhodocyànea*, Lem.). Lvs. 1–2 ft. long, with an oblong entire clasping base, the blade strongly toothed and the back marbled with whitish cross-lines, the tip rounded

128. Æchmea miniata var. discolor. (×⅙)

and mucronate: scape 1 ft. high, floccose, the several bract-lvs. pale red and erect; petals ¾in. long, pink. Brazil. B.M. 4883. B.R. 1130. F.S. 3:207.—Infl. sometimes forked.

BB. *Infl. branched (or compound).*

C. *Fls. pedicellate.*

8. **cæruléscens,** Baker. Lvs. 1½–2 ft. long, with small prickles: panicle 4–5 in. long, 2-pinnate, with lax few-fld. crowded branches; petals bluish red, ⅓in. long: fl.-bracts none or minute. S. Amer. Gt. 1871: 694.—Produces white berries.

CC. *Fls. sessile.*

D. *Sepals blunt.*

E. *Floral bracts large.*

9. **Weilbachii,** F. Didr. Lvs. rather short, overtopped by the red-stemmed and red-bracted scape: panicle narrow, 1-pinnate, the fls. rather crowded, blue and red. S. Amer. R.H. 1871:170.

Var. **leodiénsis,** André. Lvs. violet and spotted: fls. shorter. Brazil.

EE. *Floral bracts minute or wanting.*

10. **fúlgens,** Brongn. (*Æ. discolor*, Hort.). Lvs. broad, with small distant teeth, with a broad cuspidate end: panicle large, simple above, branched below, glabrous, bearing numerous fls.; petals blue-tipped, exceeding the rich red calyx; fl.-bracts minute or none: branch-bracts yellowish. S. Amer. B.M. 4293.

11. **miniàta,** Baker. Lvs. serrate with numerous close small teeth: panicle branched throughout; fls. numerous; petals blue; ovary red. Var. **díscolor,** Hort., Fig. 128, has the lvs. purple or violet-brown on the back. Brazil.

DD. *Sepals pointed or awned.*

12. **cœléstis,** Morr. Lvs. linear, the margins with few minute spines or almost smooth: panicle branched below, simple above; fls. about 10 lines long; sepals white; petals blue. Brazil.

13. **spectàbilis,** Brongn. Lvs. linear, the margins armed with stout spines: panicle laxly pyramidal; fls. about 1¼ in. long; sepals pale rose; petals white, purple at apex. Venezuela and Colombia. R.H. 1875:311.

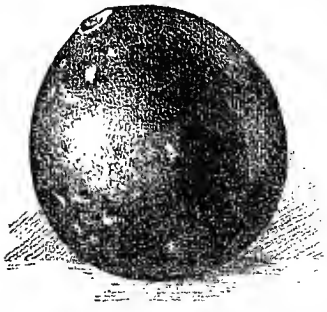
Æ. aurantìaca, Baker=Canistrum aurantiacum.—*Æ. Bárleei*, Baker. Corolla pale yellow. Honduras.—*Æ. brasiliénsis*, Regel. Lvs. much dilated at base, whitish below, black-toothed: petals light blue: calyx and rachis red; panicle branched. Brazil. Gt. 34:1202.—*Æ. bromeliæfólia*, Baker. Dense spike: lvs. whitish below, 3–4 ft. long, serrate or spinescent: fls. light yellow. S. Amer. —*Æ. Cornùi*, Carr.=Æ. nudicaulis.—*Æ. Drakeàna*, André. Lvs. whitish, finely dentate: spike simple and lax; fls. long-tubular, light blue; bracts and ovaries coral-red: berries rose, becoming blue. S. Amer. R.H. 1888, p. 401, desc.—*Æ. exsùdans*, Morr.=Gravisia exsudans.—*Æ. Fürstenbergii*, Morr.=Streptocalyx Furstenbergii.—*Æ. gigas*, Morr. Florsl lvs. crimson: fls. in a dense infl.; sepals white, lepidote; corolla pale green. Brazil. B.M. 8107.—*Æ. glomeràta*, Hook.=Hohenbergia stellata, Schult.—*Æ. Hỳstrix*, Morr. Lvs. lepidote, whitish, crowded: spike oblong, dense; fls. purple, tomentose. Guiana.—*Æ. lavandulàcea*, C. H. Wright. Fls. distichous, paniculate, the sepals awned, green, the petals deep violet. Grenada. B.M. 8005.—*Æ. macracántha*, Brongn.=Æ. Schiedeana.—*Æ. Melinònii*, Hook. Panicle 3-pinnate, dense; petals bright red: lvs. spiny, 1½–2 ft. Guiana. B.M. 5235.—*Æ. mexicàna*, Baker. Lvs. long and large, fine-toothed: panicle 2-pinnate, long and lax, the peduncles mealy; petals crimson. Mex.—*Æ. miniàta*, Hort.=Billbergia thyrsoidea(?).—*Æ. myriophýlla*, Morr. Allied to Æ. distichantha. Lvs. narrow, 2–3 ft., spiny, silvery-scaly on the back: fls. red, the petals fading blue. Trop. Amer. B.M. 6939.—*Æ. nudicaùlis*. Griseb. Lvs. long and straight, brown-toothed: bract-lvs. subtending: spike large, brilliant red; petals yellow. Trop. Amer. R.H.1885:36 (as Æ. Cornui, which is a form with shorter and denser spike).—*Æ. paniculígera*, Griseb. Lvs. large and long: panicle 1–2 ft. long, with few-fld. branches; scape tall, reddish, downy; fls. purple. Trop. Amer.—*Æ. Schiedeàna*, Schlecht. (Æ. macracantha, Brongn.). Lvs. large, rigid, strongly armed: panicle 3-pinnate, pubescent; fls. pale yellow. Mex. Gt. 43 p. 175.—*Æ. serràta*, Mez. Panicle very dense, bipinnate; fls. distichous, sessile; sepals spinulose; petals violet, mucronate. Martinique. R.H. 1907:129—*Æ. zebrìna*=Billbergia zebrina.

L. H. B.
GEORGE V. NASH.†

ÆGLE (from Latin *Ægle*, one of the Hesperides). *Rutàceæ*, tribe *Citreæ*. A small tree, often spiny, having hard-shelled frs.: lvs. deciduous: fls. pentamerous with numerous free stamens; ovary with 10 or more cells; ovules numerous in each cell; cells of the fr. without pulp vesicles, filled with gum; seeds woolly and in germination the cotyledons remain hypogeous: the first foliage lvs. are opposite.—Only one species is now recognized.

Mármelos, Correa (*Cratèva Mármelos*, Linn. *Bèlou Mármelos*, W. F. Wight). Fig. 129. The bael fruit of India. A handsome tree native to N. India, but widely cult. throughout the Peninsula as well as in Ceylon, Burma, Siam and Indo-China. The trifoliolate lvs., borne on wingless petioles, are thin in texture, probably owing to the fact that they are deciduous. Although not so hardy as the deciduous trifoliate orange of China and Japan, the bael fruit tree is said to endure a considerable degree of cold (20° F. or lower) in the drier parts of N. W. India. The fr. is greenish yellow, globular, or nearly so, varying from 2–6 (usually 4–5) in. in diam. The fr. of the wild tree is considerably smaller than that of the cult. form. The hard shell, ⅛in. thick, is filled with the pale orange, aromatic pulp in which occur 10–15 long, narrow cells containing the seeds imbedded in transparent tenacious gum. These cells correspond to the segms. of an orange, while the pulp is made up of the pith and the greatly thickened fleshy membranes separating the

cells. Ill. Roxb., Pl. Corom., pl. 143. Wight, Ic., pl. 16. Bedd., Fl. Sylv., pl. 161. Benth. & Trim., Med. Pl., 55. Bonav., Oranges and Lemons of India and Ceylon, Atlas, pl. 242, 243. The ripe fr. is much esteemed by the Hindus, many of whom consider it the best of the citrous frs.; the European residents in India often become very fond of it.



129. Ægle Marmelos. (×⅓)

Watt says (Dict. of Econom. Prod. of India, 1:123): "The fruit, when ripe, is sweetish, wholesome, nutritious, and very palatable, and much esteemed and eaten by all classes. The ripe fruit, diluted with water, forms, with the addition of a small quantity of tamarind and sugar, a delicious and cooling drink." The famous botanist, Roxburgh, says (Flora Indica, 2:580): "The fruit is nutritious, warm, cathartic; in taste delicious, in fragrance exquisite; . . ."

On the other hand, W. R. Mustoe, Superintendent, Government Archeological Gardens, Lahore, India, writes (in a letter to D. G. Fairchild, dated Lahore, Dec. 3, 1908): "The fruit is greatly prized for eating by the natives, but can scarcely be looked upon as palatable to the white man except as a sherbet; . . ." Sherbet is made from the mashed pulp, which is diluted with a little water, and then strained into milk or soda-water and sugared to taste. Sometimes a little tamarind is added to give a subacid flavor. All Indian medical authorities agree that the bael fruit has a most salutory influence on the digestive system. The ripe fruit is mildly laxative and is a good simple remedy for dyspepsia. The unripe fruit is a specific of the highest value for dysentery, but so mild that it can be given to children without danger. The bael fruit tree is widely cultivated in India, and is found in nearly every temple garden. It is dedicated to Siva, whose worship cannot be completed without its leaves. This promising fruit tree is now being tested at several points in the warmer parts of the United States.

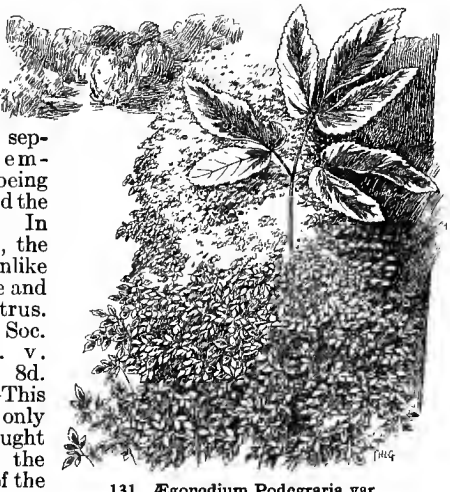
Æ. Bárteri, Hook. f.=Balsæmocitrus paniculata, Swingle.—*Æ. decándra*, Naves=Chætospermum glutinosa, Swingle.—*Æ. glutinòsa*, Merrill=Chætospermum glutinosa, Swingle.—*Æ. sepiària*, DC.=Poncirus trifoliata, Raf.

WALTER T. SWINGLE.

130. Æglopsis Chevalieri. (×⅘; fl. ×⅞)

ÆGLÓPSIS (*Ægle; opsis*, appearance). *Rutàceæ*, tribe *Citreæ*. A small spiny tree, having simple persistent lvs. with short, wingless petioles, and frs. with a thin rather hard shell: the fls. are pentamerous with 10 stamens, ovary 6–7-celled, ovules numerous in each cell: cells of the fr. without pulp vesicles, filled with gum. The seeds are smooth, and in germination the cotyledons remain hypogeous; the first foliage lvs. are opposite. Only one species is known.

Chevalièri, Swingle. Fig. 130. A large shrub or small spiny tree growing near the coast in Côte d'Ivoire, Trop. W. Afr., probably occurring also in Liberia. The spines occur singly alongside of the axillary bud and are long, slender and straight. (See Fig. 130.) The fls. are borne in small, more or less branched panicles composed of 4–40 fls. The fruits are globose or slightly pyriform, deep orange, with a thin, hard shell $\frac{1}{16}$in. thick. Inside of this shell are 6 (rarely 5 or 7) cells filled with large sublenticular seeds imbedded in a fragrant mucilage. These cells correspond to the segms. of an orange and are triangular in outline, occupying almost the whole space, the separating membranes being very thin and the pith small. In this respect, the fr. is quite unlike frs. of Ægle and Balsamocitrus. Ill. Bull. Soc. Bot. Fr. v. 58. Mém. 8d. pl. 2, 3.—This species was only recently brought to light in the collections of the Muséum d'Histoire Naturelle at Paris. It is reported as growing in swamps near the sea. If it is able to resist brackish water it may prove to be a stock of value on which to graft citrous frs. as most, if not all, of the species of Citrus are very sensitive to salty soils (alkali). Trees of this species are growing in the greenhouses of the Jardin des Plantes at Paris and in those of the U. S. Dept. of Agric. Young seedlings are being grown for trial as stocks on which to graft other citrous frs. WALTER T. SWINGLE.



131. Ægopodium Podograria var. variegatum.

ÆGOPÒDIUM (*aix*, goat, and *podion*, a little foot; probably from the shape of the lfts). *Umbellíferæ*. GOUTWEED. Coarse, hardy herbaceous perennial, with creeping rootstocks, biternate lvs., sharply toothed, ovate lfts., white fls. in umbels: frs. ovate, glabrous, with equal filiform ribs, and no oil-tubes.

Podogrària, Linn., var. **variegâtum,** Hort. Fig. 131. Twelve to 14 in.—A rapid-growing variegated form of this European weed, which makes attractive mats of white-margined foliage. Common in yards, and planted as edging and mats against buildings and in shady places. Prop. readily by division, and of simplest cult.

N. TAYLOR.†

AËRÁNTHUS: Certain species described under this genus are treated in *Angræcum*.

AÉRIDES (Greek, *air-plant*). *Orchidàceæ*. Epiphytic hothouse orchids.

Stems leafy, without pseudobulbs: lvs. distichous, coriaceous or fleshy, the persistent sheaths covering the

st.: fls. borne in simple or compound lateral clusters; sepals about equal, spreading, the dorsal broader than the lateral; petals similar to the dorsal sepal; lip erect, or bent in, attached to the foot of the column, spurred at the base, the spur hollow; pollinia 2.—Species about 30, distributed from Malay Archipelago to India, E. Asia and Japan.

Nearly all the species of this genus are from the East Indies and therefore require the warmhouse treatment, with a minimum of 65° F. in winter. As they have no pseudobulbs, but an erect, evergreen stem, they must never be allowed to become perfectly dry. Ample drainage of charcoal and broken pots is very essential, with a surfacing of moss, preferably sphagnum, renewed each year, the usual peat fiber being omitted. The best-known species is *A. odoratum* and is often seen in collections flowering freely. *A. Fieldingii* is also an interesting plant, as the spikes grow to the length of 18 inches, are dense-flowered, and known as the "fox-brush orchid," the color being a beautiful rose-pink. *A. Lawrenciæ* is another fine plant, from the Philippines but not yet common in gardens.—Propagation is effected only by cutting off the top of the plant and setting it down in another pot, and waiting for the other part to send out shoots. The roots are mostly aërial, and no attempt must be made to confine these to the pots. If the size pot used is large, it should be perforated at the sides to admit of a free circulation of air. (Orpet.)

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KEY TO THE SPECIES.

A. *Lvs. flat, keeled.*
  B. *Middle lobe of the lip incurved between the larger lateral lobes.*
    C. *Spur curved.*
      D. *Fls. 1½ in. long or less.*
        E. *Lateral lobes of the lip white.*
          F. *Length of fls. 1 in. or more.*
            G. *Lip not spotted or with few spots; fls. crowded, concealing the stem* .... 1. **odoratum**
            GG. *Lip usually much spotted; fls. not crowded, revealing the stem* ..... 2. **virens**
          FF. *Length of fls. less than 1 in.*.. 3. **quinquevulnerum**
        EE. *Lateral lobes of the lip lemon-yellow* ..... 4. **suavissimum**
      DD. *Fls. exceeding 1½ in. long*..... 5. **Lawrenciæ**
    CC. *Spur straight.*
      D. *Raceme much longer than the lvs.; middle lobe of the lip ovate-triangular* ..... 6. **Leanum**
      DD. *Racemes as long as the lvs.; middle lobe of the lip linear-oblong.* 7. **Savageanum**
  BB. *Middle lobe of the lip spreading, not incurved.*
    C. *Sts. long: lvs. numerous, 5 in. or more long.*
      D. *Lateral lobes of lip large, usually falcate or lunate.*
        E. *Spur short, conic.*
          F. *Sepals and petals white* .... 8. **falcatum**
          FF. *Sepals and petals tawny yellow* ..... 9. **Houlletianum**
        EE. *Spur long, cylindric.*
          F. *Shape of spur straight*.....10. **Augustianum**
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      DD. *Lateral lobes of lip smaller or wanting.*
        E. *Racemes drooping or pendulous.*
          F. *Middle lobe of lip entire.*
            G. *The spur straight.*
              H. *The middle lobe of lip cordate, obtuse*.....12. **multiflorum**
              HH. *The middle lobe of lip deltoid, acuminate* ..13. **Fieldingii**
            GG. *The spur incurved or hooked*.....14. **maculosum**
          FF. *Middle lobe of lip serrate; lateral lobes small*.....15. **crispum**
        EE. *Racemes erect or ascending*...16. **radicosum**
    CC. *Sts. short: lvs. few, 4 in. long or less*.....17. **japonicum**
AA. *Lvs. terete or semiterete, grooved on the upper surface.*
  B. *Fls. few, white, 2 in. or more across*..18. **vandarum**
  BB. *Fls. numerous, less than 1 in. across, the lip violet*.....19. **mitratum**

1. **odorâtum,** Lour. (*A. cornùtum,* Roxbg.). Fig. 132. Lvs. 6–8 in. long, up to 2 in. broad: racemes nodding, equaling or longer than the lvs.; fls. about 1 in. long, fragrant; sepals and petals white, with a carmine spot at the obtuse apex, the petals narrower than the sepals; lateral lobes of the lip erect, round-oblong, white, or faintly tinged with purple, and somewhat spotted; middle lobe of the lip linear-oblong, denticulate or entire, white, with a median purple line. India to Cochin China. B.M. 4139. Gn. 49, p. 158. F.C. 2:75. O.R. 6:273; 8:217. Var. **birmânicum,** Reichb. f. Fls. smaller, with lines instead of apical spots, and the narrow middle lobe of the lip with few marginal teeth. Var. **purpurâscens,** Hort. Racemes larger, and the sepals and petals tipped with dull amethyst. G.C. II. 16:597. Var. **mâjus,** Hort. Racemes and fls. larger.

132. Aerides odoratum (×⅛)

2. **vîrens,** Lindl. Lvs. up to 10 in. long and 1¼ in. broad: racemes longer than the lvs.; fls. over 1 in. long, fragrant; sepals and petals white, with a bright purple apical spot, broadly oval, obtuse; lip deeply 3-lobed, the oblong lateral lobes much the larger, erect, white, purple-spotted below, the middle lobe oblong, small, incurved, purple, or white with a median purple stripe; spur green-tipped. Java. P.M. 14:197. B.R. 30:41. Var. **Ellisii,** Hort. (*A. Ellisii,* Hort.). Sepals and petals white, flushed with rose, the tips amethyst-purple. Var. **Dayânum,** Hort. Racemes longer, with large bright fls. Var. **Sânderæ,** Hort. A form in which the fls. are pure white.

3. **quinquevûlnerum,** Lindl. Lvs. up to 1 ft. long and 1½ in. broad: racemes commonly longer than the lvs.; fls. usually less than 1 in. long; sepals and petals obtuse, oval-oblong, white, tipped with amethyst and with a few purple spots below; lip 3-lobed, the erect lateral lobes triangular-oblong, white, faintly purple-dotted, the middle lobe oblong, deep amethyst, the spur incurved green. Philippine Isls. P.M. 8:241. Var.

Rœbelínii (*A. Rœbelínii*, Reichb. f.). Differs in the denticulate petals which shade to green at the base, and in the rose-colored middle lobe of the lip. Philippine Isls.

4. **suavíssimum,** Lindl. Lvs. up to 10 in. long and 1½ in. broad: racemes longer than the lvs.; fls. fragrant, somewhat crowded; sepals and petals white, flushed with lilac, tipped with rose-lilac, the dorsal sepal broadly oval, the lateral larger; lip 3-lobed, the erect lateral lobes rounded-oblong, lemon-yellow, purple-spotted, the middle lobe linear-oblong, paler than the lateral lobes. Malacca. C.O., pl. 6. J.F. 2, pl. 213. Var. **Ballantineànum,** Veitch. Blooms a little earlier: racemes shorter, the sepals and petals amethyst-tipped.

5. **Láwrenciæ,** Reichb. (*A. Lawrenciànum*, Hort.). Lvs. up to 1 ft. long and 2 in. broad: racemes equaling or longer than the lvs.; fls. over 1½ in. long, fragrant; sepals and petals white, amethyst-tipped; lip deeply 3-lobed, the denticulate lateral lobes hatchet-shaped, white, the middle lobe oblong, amethyst, the spur green, incurved. Philippine Isls. Gn. 35:485. G.C. III. 20: 629; 30:435. Var. **Amesiànum,** Kränzl. A more robust plant, with fls. of a more intense color. Var. **Sanderiànum,** Hort. Differs in its narrow lvs. and yellowish fls.

6. **Leànum,** Reichb. f. Lvs. up to 10 in. long and 1½ in. broad: racemes longer than the lvs.; fls. less than 1 in. long; sepals and petals rose-purple with a white base; lip 3-lobed, the lateral lobes round, incurved, and nearly inclosing the small, ovate-triangular, deep purple middle lobe; spur straight, green-tipped. India.

7. **Savageànum,** Veitch. Lvs. up to 10 in. long and 1¼ in. wide: racemes equaling the lvs.; fls. less than 1 in. long; sepals and petals with the white base dotted with purple, the upper portion crimson; lip crimson-purple, the erect lateral lobes round-oblong, the middle lobe linear-oblong, small, incurved; spur straight, greenish.

8. **falcàtum,** Lindl. & Paxt. (*A. Larpéntæ*, Hort. *A. expánsum*, Reichb. f.). Lvs. up to 8 in. long and 1½ in. broad: racemes equaling or exceeding the lvs.; fls. about 1¼ in. long; sepals and petals white, tipped with amethyst-purple; lip 3-lobed, the spreading lateral lobes falcate, light amethyst, the middle lobe deep amethyst, broadly obovate, notched, denticulate; spur short, greenish. Upper Burma. Var. **Leònæi** (*A. Leònæi*, Reichb. f.). Differs in having the middle lobe of the lip larger and of deeper color, and in the dotting of the lateral lobes and of the base of the sepals and petals. Rangoon.

9. **Houlletiànum,** Reichb. f. Resembles *A. falcatum*, but differs in its smaller fls., arranged in shorter and denser racemes, the sepals and petals tawny yellow, tipped with purple, the lip white, striped and spotted with purple, the middle lobe fimbriate. Cochin China. C.O., pl. 3. I.H. 29:455. R.B. 21:205. R.H. 1891:324.

10. **Augustiànum,** Rolfe. Lvs. up to 8 in. long and 1¼ in. broad: racemes longer than the lvs.; fls. 1–1¼ in. long; sepals and petals rose, round-oblong, obtuse; lip 3-lobed, the oblong lateral lobes falcate, rounded or truncate at the summit, the broadly oblong middle lobe crenulate, somewhat bilobed at the apex; spur straight. Philippine Isls. G.C. III. 7:233.

11. **crassifòlium,** Par. & Reichb. f. Lvs. up to 8 in. long and 2 in. wide: racemes longer than lvs.; fls. loosely arranged, 1–1½ in. long; sepals and petals rose-purple, paler at the base; lip 3-lobed, the lateral lobes rose-purple, nearly lunate or crescent-shaped, the broadly ovate middle lobe deep rose-purple; spur curved, greenish at the tip. Burma. G.C. II. 8:493. C.O., pl. 1.

12. **multiflòrum,** Roxbg. (*A. affine*, Wall. *A. ròseum*, Paxt.). Lvs. up to 10 in. long, less than 1 in. broad: racemes longer than the lvs.; fls. about ¾in. long; basal portion of the oval-oblong petals and dorsal sepal white, with a few purple spots, the remainder light amethyst, the nearly orbicular lateral sepals white, faintly flushed; lip light amethyst, deeper in the middle, cordate, obtuse; spur straight, short. B.M. 4049. Gt. 8:267. J.F. 2:200. Var. **Lóbbii,** Veitch (*A. Lóbbii*, Hort.). Differs from the type in its much-crowded lvs., and in the fls. which are more numerous and more highly colored. I.H. 15:559. Var. **Godefroyànum,** Veitch (*A. Godefroyànum*, Reichb. f.). Lvs. longer: fls. a little larger and more highly colored than in the type. R.B. 17:169.

13. **Fièldingii,** Lodd. Fox-brush Orchid. Lvs. up to 10 in. long and nearly 2 in. broad: infl. racemose, sometimes paniculate at the base, longer than the lvs.; fls. about 1½ in. long, crowded; petals and dorsal sepal white, suffused with rose, or the basal portion sometimes white and dotted with purple, obovate, the lateral sepals white, tipped with pale purple, broadly oval; lip white, suffused with rose, deltoid or trowel-shaped, acuminate, the small lateral lobes inrolled over the mouth of the small white spur which is amethyst, mottled with white. Sikkim and Assam. B.H. 1876:18, 19. A.F. 22:883.

14. **maculòsum,** Lindl. Lvs. up to 10 in. long and nearly 2 in. broad: infl. longer than the lvs., often paniculate at the base; fls. about 1½ in. long, the sepals and petals white, the upper portion stained and spotted with amethyst, oval-oblong; lip clawed, the blade amethyst, deeper in the middle, ovate-oblong, obtuse, with 2 small white tubercles at the base; spur incurved, short, green-tipped. India. Var. **Schroëderi,** Veitch. Differs from the type in its more robust habit, its longer lvs., and the darker markings of the sepals, petals, and middle of the lip. G.C. II. 13:493; 17:341. J.F. 1:54.

15. **crîspum,** Lindl. (*A. Broòkei*, Batem.). Lvs. up to 8 in. long and 2 in. broad: infl. several times longer than the lvs., racemose, or sometimes paniculate at the base; fls. about 2 in. long, the sepals and petals white, faintly flushed with rose-purple on the back and on the surface at the apex; lip 3-lobed, the erect, small lateral lobes white, streaked with rose-purple on the surface, round-oblong, the middle lobe deep amethyst, white at the base, broadly ovate, the sides reflexed, serrate; spur small, curved. S. India. B.M. 4427. F.S. 5:438. Gn. 4, p. 85. B.R. 28:55. F.S. 1:42. G.C. III. 36:134. Var. **Lindleyànum,** Hort. Infl. paniculate at the base; fls. larger than in the type, the lip with the lateral lobes greenish and the middle lobe rich amethyst bordered with white. Neilgherry Hills. Var. **Wárneri,** Hort. Differs in having the lvs. shorter and narrower than in the type, and in its longer racemes of smaller fls., the middle lobe of the lip deep rose with a white border.

16. **radicòsum,** Reichb. (*A. rùbrum*, Hort.). Lvs. up to 10 in. long and 1½ in. broad: infl. longer than the lvs., racemose, or sometimes paniculate at the base; fls. about 1¾ in. long, the sepals and petals light rose-purple, deeper spotted; lip 3-lobed, the small erect lateral lobes round, rose-purple, the middle lobe deep rose-purple, oblong, acute; spur curved, short. India.

17. **japónicum,** Reichb. f. Lvs. up to 4 in. long, few: racemes longer than the lvs.; fls. about 1 in. long, fragrant; sepals and petals greenish white, the lateral sepals bordered with brownish purple; lip 3-lobed, the lateral lobes small, the middle lobe obovate-spatulate, crenulate, white, with a median dark violet ridge and a few paler spots; spur straight, obtuse. Japan. B.M. 5798. I.H. 29:461.

18. **vandárum,** Reichb. f. (*A. cylíndricum*, Hook.). St. slender, round: lvs. terete, grooved on the upper surface, up to 8 in. long: fls. single or in few-fld. racemes, white, about 2 in. long; sepals and petals undulate, the former obovate-oblong, the latter nearly rhomboidal; lip 3-lobed, the lateral lobes linear-falcate, the middle

lobe broadly obcordate; spur subulate. Himalayan region. B.M. 4982. J.H. III. 34:417. O.R. 13:60.

19. **mitràtum**, Reichb. f. St. short, with a few semiterete lvs. 6–15 in. long, deeply grooved on the upper surface: racemes from below the lvs. and shorter than them, ascending or nearly erect; fls. ¾in. long; sepals and petals white, flushed with mauve at the apex; lip amethyst; spur miter-shaped, short. Burma. B.M. 5728.

A. Micholítzii, Rolfe. A recently intro. species, allied to A. odoratum. Light rose-purple fls. and a rather short spur. Annam. O.R. 1904:181.—*A. cylíndricum*, Lindl. Resembles A. vandarum in habit and foliage. Fls. about 1½ in. across; the sepals and petals waxy white, sometimes tinged rose, the lip white, the side lobes purple-streaked, the middle lobe yellow with a crimson tip. India. G.C. III. 17:393.—*A. Duquésnei*, Hort. Fls. white dotted with rose.—*A. Emeríci*, Reichb. Fls. 1 in. long, the sepals and petals white, amethyst-blotched at apex, the side lobes of lip purple-spotted, the middle lobe small, narrowly oblong, acute, amethyst; spur incurved. B.M. 6728.—*A. Thibautiànum*, Reichb. Racemes longer than the lvs.: fls. rose with an amethyst lip; spur curved.

GEORGE V. NASH.

ÆRUA (said to be from the Arabic name). *Amarantàceæ*. A genus of 10 species of Trop. Asiatic and African herbs or shrubs, allied to Achyranthes, with perfect or imperfect fls., the perianth segms. short and hyaline; stamens 5 or 4, sterile filaments intervening; fls. very small, usually in clusters, white or rusty.

sanguinolénta, Blume (*A. sanguínea*, Hort.). Lvs. 1½–2½in. long, opposite or alternate, ovate-acuminate,

133. Opening foliage of Æsculus Hippocastanum.

soft-pubescent, pale beneath. Java.—Cult. for its dark red lvs. Not common and at present perhaps confined to botanic gardens.

N. TAYLOR.†

ÆSCHYNÁNTHUS: *Trichosporum*.

ÆSCULUS (ancient name of some oak or mast-bearing tree). Including *Pàvia*. *Hippocastanàceæ*. HORSE-CHESTNUT. BUCKEYE. Trees or sometimes shrubs, cultivated for shade and for the conspicuous bloom of some species.

Winter-buds large with several pairs of outer scales: lvs. opposite, long-petioled, digitate, deciduous; lfts. 5–9, serrate: fls. symmetrical in terminal panicles; calyx campanulate to tubular, unequally 4–5-toothed; petals 4–5, with long claws; stamens 5–9; ovary 3-celled, with 2-ovuled cells: fr. a large 3-valved caps., usually with 1 or 2 large seeds; seeds large, brown, with a large pale hilum.—About 20 species in N. Amer., E. Asia, Himalayas and Balkan Peninsula.

The buckeyes are deciduous trees and shrubs, with large, digitate leaves and red, white or yellow flowers in showy terminal panicles. They are cultivated for their showy flowers and handsome foliage, and some species make excellent shade trees. The large seeds are not edible.

Some species, as *Æ. Hippocastanum* and *Æ. carnea* are popular shade and street trees. They leaf early and soon give a dense shade. The shrubby species are well adapted for borders of larger groups or as solitary clumps on the lawn, particularly *Æ. parviflora*, with its slender panicles of white flowers; similar in habit and effect but with bright scarlet flowers, are *Æ. discolor*, *Æ. georgiana* and *Æ. splendens*. Most of the species are hardy North, but the Californian and Himalayan species are suitable only for the southern states. They grow best in loamy and moist soil.

Propagation is by seeds to be sown in autumn or stratified, or by side-grafting and budding on common species, and the shrubby forms also by layers; *Æ. parviflora* is propagated also by root-cuttings.

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A. *Winter-buds resinous: claws of petals not longer than calyx; stamens exserted.*

B. *Lfts. sessile: petals 5; calyx campanulate, 5-lobed; stamens 5–8: fr. globular.* (*Hippocastanum*).

C. *Lvs. glabrous beneath.*

1. **Hippocástanum**, Linn. COMMON HORSE-CHESTNUT. Fig. 133. Large tree, 60–80 ft.: lfts. 5–7, sessile, cuneate-obovate, acuminate, obtusely serrate, nearly glabrous: panicles 8–12 in. long, very showy; fls. white, tinged with red, ¾in. long: fr. echinate. May. N. Greece, Bulgaria. H.W. 3:47. F.E. 13, pl. 13 (habit).—Many garden forms; the most important are: Var. **Baumánnii**, Schneid. (var. *flòre-plèno*, Lem.), with double white fls. I.H. 2:50. F.S. 7, p. 75. B.H. 4, p. 133. G.M. 44:613. A.G. 32:271 (habit). Var. **Schirnhòferi**, Rosenth., with double yellowish red fls. W.I.G. 1882:101. Var. **pûmila**, Dipp., dwarf form. Var. **umbraculífera**, Rehd., with compact round head. M.D.G. 1903:188. Var. **pyramidâlis**, Nichols., with compact, narrow, pyramidal head. Var. **laciniâta**, Leroy (var. *dissécta*, Hort., var. *heterophýlla*, Hort.), lfts. laciniate. Var. **incîsa**, Dipp. Lfts. short and broad, deeply and doubly serrate to incisely lobed. Var. **Hénkelii**, Henkel, is little different, only the lfts. are narrower and the habit more pyramidal. Var. **variegâta**, Loud., lvs. variegated with yellow. Var. **Memmíngeri**, Bean. Lvs. sprinkled with white.—The horse-chestnut is one of the most popular of shade trees on the continent of Europe, and is also much planted along roads and in parks and private grounds in this country. It is particularly adaptable for bowers and places where seats are desired, as the top stands heading-in and makes a very dense shade. It is the first of all shade trees to burst into leaf. When smaller, more formal trees are desired, var. *umbraculifera* should be planted. The double-fld. forms are to be recommended for the longer duration of their fls. and for the absence of the fr. which is of great, often annoying, attraction to the small boy. In dry situations, the planting of the horse-chestnut should be avoided, as the foliage is likely to suffer, particularly in dry seasons, from drought and heat.

2. **cárnea,** Hayne (*Æ. Hippocástanum* × *Pàvia. A. rubicúnda,* Loisel., *Æ. intermèdia,* André). Tree, 20–40 ft.: lfts. mostly 5, nearly sessile, cuneate-obovate, crenate-serrate, nearly glabrous: panicles 5–8 in. long; fls. varying from flesh-color to scarlet: fr. with small prickles. Garden origin. B.R. 1056. L.B.C. 13:1242. F.S. 2229–30. F.E. 23:607 (habit).—Common in parks and on roadsides. Handsome and desirable; the foliage is darker and of firmer texture than that of the preceding species and resists drought better. Many garden forms, according to the different shades in coloring; one of the best is var. **Briòtii,** Nichols. (*Æ. rubicúnda* var. *Briòtii,* Carr.), with bright scarlet fls. R.H. 1878: 370. Also var. **plantierénsis,** Rehd. (*Æ. plantierénsis,* André), with yellowish white fls. tinged with pink and fading to pink and with bluntly serrate lfts., is very handsome.

cc. *Lvs. pubescent beneath, at least while young.*

3. **turbinàta,** Blume (*Æ. sinénsis,* Hort., not Bunge). Japanese Horse-Chestnut. Tree, 30 ft.: petioles and young branchlets pubescent; lfts. 5–7, cuneate-obovate, crenate-serrate, pubescent beneath when young: panicles 6–10 in. long, dense and rather narrow, pubescent; fls. yellowish white, with a red spot, less than ½in. long: fr. verrucose. June. Japan. G.C. III. 5:717; 31:187. S.I.F. 1:71.—The lvs. are larger than those of the preceding species, but the individual fls. are smaller and less strongly marked with red. Hardy at the Arnold Arboretum.

bb. *Lfts. stalked: petals 4; calyx 2-lipped; stamens 7–9: fr. pear-shaped, smooth.* (*Calothyrsus.*)

c. *Petals nearly equal, oblong-obovate to oblanceolate.*

d. *Corolla about 1 in. long.*

4. **californica,** Nutt. California Buckeye. Tree with broad top, 30–40 ft.: lfts. 5–7, petioled, oblong-lanceolate, cuneate or obtuse at the base, sharply serrate, glabrous, 4–6 in. long: panicles 3–8 in. long, rather dense; fls. white or pale rose-colored, 1 in. long; petals of equal length. Calif. B.M. 5077. R.H. 1855, p. 150. Gn. 49, pp. 490, 492. S.S. 2:71, 72. F.S. 13:1312. G.C. III. 31:186. G.M. 55:577 (habit).

dd. *Corolla much less than 1 in. long.*

5. **chinénsis,** Bunge. Tree, to 60 ft.: lfts. 5–7, short-stalked, oblong-obovate to oblong-oblanceolate, acuminate, cuneate at the base, glabrous beneath, except sparingly hairy on the veins, closely serrulate, 4–7 in. long: fls. less than ½in. long, white, in elongated cylindric panicles: fr. subglobose, slightly depressed at the apex, with thick walls; seeds 1 in. across or less with the hilum occupying about one-half of the seed. May, June. N. China. G.C. III. 52:346, 347.—Recently intro. by the Arnold Arboretum and probably hardy N.

6. **Wilsonii,** Rehd. Tree, to 80 ft.: lfts. 5–7, stalked, oblong-obovate to oblong-oblanceolate, acuminate, rounded or broadly cuneate at the base, densely grayish pubescent beneath while young, 4–9 in. long: fls. about ½in. long, the upper petals with a yellow spot, in cylindric panicles 6–12 in. long: fr. ovoid, somewhat pointed at the apex, with thin walls; seeds 1½ in. across with the hilum occupying one-third or less of the seed. May, June. W. and Cent. China.—Recently intro. by the Arnold Arboretum, but proved tender in Mass.; probably hardy south of New York, and a tree highly to be recommended for its very large spikes of white fls.

cc. *Petals unequal, about 1 in. long, the upper ones marked red and yellow, oblanceolate, the lateral ones with oval or obovate blade.*

7. **indica,** Colebr. Tall tree, to 60 ft.: lfts. 5–9, obovate-lanceolate, short-stalked, finely serrate, cuneate at the base, glabrous or nearly so beneath, 6–10 in. long: panicle to 15 in. long, narrow; fls. about 1 in. long with white unequal petals, the upper with yellow blotch, the lower tinged rose. Himalayas. B.M. 5117. G.C. 33:139; 36:206. Gn. 76, p. 399.—A handsome tree with large foliage and showy fls., hardy only in the southern states.

aa. *Winter-buds not resinous: claws mostly longer than the 5-toothed calyx.*

b. *Fls. yellow to scarlet; petals 4; stamens included or somewhat exserted: lfts. petioled.* (*Pavia.*)

c. *Petals villous at the margin (interspersed with glands in the hybrid).*

d. *Color of fls. yellow; margin of petals without glands.*

8. **glàbra,** Willd. (*Æ. ohioénsis,* Michx. *Pàvia glàbra,* Spach. *P. pállida,* Spach). Ohio Buckeye. Small tree, 15–30 ft.: lfts. 5, oval or cuneate-obovate, finely serrate, smooth: panicles 5–6 in. long; fls. greenish yellow; petals of nearly equal length, their claws as long as the calyx; stamens exserted: fr. echinate. May. Pa. to Ala. and Iowa. B.R. 24:51. S.S. 2:67, 68. F.E. 29: 773 (habit). Var. **Bùckleyi,** Sarg. (*Æ. glàbra* var. *argùta,* Rob. partly). Shrub: lfts. 6–7, obovate-lanceolate, unequally serrate, more acuminate, finely pubescent beneath. Has been confounded with the true *Æ. arguta,* Buckl.

9. **octándra,** Marsh. (*Æ. flàva,* Ait. *Æ. lùtea,* Wang. *Pàvia lùtea,* Poir.). Sweet Buckeye. Large tree, 40–90 ft.: lfts. 5, oblong-obovate or elliptical, cuneate,

134. Æsculus georgiana. (×⅛)

equally serrate, smooth or pubescent beneath: panicles 4–6 in. long; petals yellow, very unequal, their claws longer than the calyx; stamens 7, shorter than the petals: fr. smooth. May, June. Pa. to Ga. and Iowa. L.B.C. 13:1280. S.S. 2:69, 70. G.W. 7, p. 145 (habit).

dd. *Color of fls. red or yellow tinged more or less with red.*

e. *Margin of petals without glands, villous.*

10. **georgiàna,** Sarg. Fig. 134. Shrub, to 6 ft.: lfts. 5, stalked, oblong-obovate, long-pointed, finely and often doubly serrate, pale yellowish green beneath and quite glabrous: fls. 1¼ in. long, in dense panicles 5–6 in. long; calyx narrow-campanulate, red; petals red and yellow; very dissimilar, the lateral ones broad, usually rounded at the base; stamens 7, shorter than the petals, villous below the middle. May, June. Ga. S.T.S. 2:197.—This is the only species of the *Æ. octandra* group with red and yellow fls.: it is very handsome and has proved perfectly hardy at the Arnold Arboretum.

11. **wœrlitzénsis,** Koehne. Tree: lfts. obovate-oblong, yellowish green beneath, sparingly hairy along the midrib and bearded in the axils, otherwise quite glabrous, with 17–20 pairs of veins: fls. 1–1¼ in. long, in

panicles 4–5 in. long; calyx tubular, wider above the middle; petals red, the lateral ones with an oblong-oval or oblong-obovate blade gradually narrowed at the base; stamens as long as the lateral petals. May. Of garden origin. Var. **Ellwángeri,** Rehd. (*Æ. Pàvia* var. *Whitleyi*, Ellwanger & Barry, not Hort. Angl. *Æ. Pàvia* var. *atrosanguínea*, Hort.). Lfts. slightly hairy on the whole under surface while young, with 20–27 pairs of veins: fls. darker red; calyx narrower, not widened above the middle. Origin unknown.—Very similar to *Æ. Pavia*, but easily distinguished by the villous margin of the petals.

EE. *Margin of petals with hairs and glands: fls. yellow and reddish.*

12. **hýbrida,** DC. (*Æ. octándra* × *Pàvia*, *Æ. versicolor*, Wender. *Pàvia hýbrida*, Spach. *Æ.* or *P. Lyonii*, Hort.). Intermediate between *Æ. octandra* and *Æ. Pavia*. Lfts. pubescent beneath along the veins, short-petioled, minutely crenulate-serrate: calyx narrow-campanulate, red or yellowish red; petals yellow or reddish; stamens shorter than petals, pubescent toward the base. May, June. Garden origin. W.D.B. 2:164 (as *Æ. Pavia*).—Several forms of this hybrid are in cult., varying in the color of the fls. from yellow, slightly tinged with red, to nearly red. Here belong also several forms cult. in gardens as *Æ. discolor* and *Æ. Pàvia* var. *argùta*, Lindl., with red fls. (B.R. 993).

CC. *Petals only glandular, not villous on the margin, red, or red and yellow.*

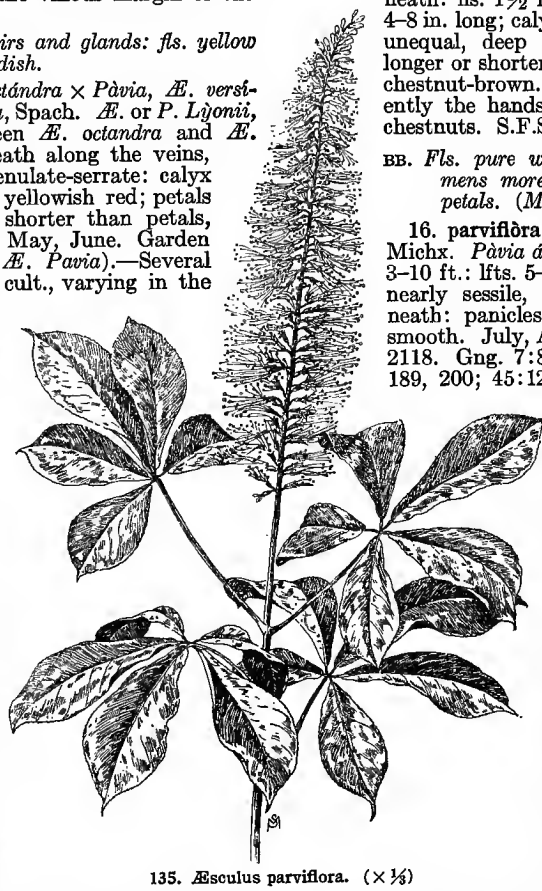
D. *Lvs. glabrous beneath or only slightly pubescent along the midrib.*

13. **Pàvia,** Linn. (*Pàvia rùbra*, Poir. *P. Michaùxii*, Spach). RED BUCKEYE. Shrub or small tree, 4–20 ft.: lfts. oblong or elliptical, acute at both ends, finely serrate, smooth or pubescent beneath: panicles 4–7 in. long, loose; fls. purplish to dark red; calyx tubular; petals very dissimilar; stamens mostly 8, nearly as long as the petals: fr. smooth. May, June. Va. to Fla. and La. L.B.C. 13:1257. S.T.S. 2: 199.—Many garden forms, as var. **hùmilis,** Mouillef. (*Æ. hùmilis*, Lodd. *Æ. Pàvia* var. *nàna*, Dipp. *Æ. Pàvia* var. *péndula*, Hort. *Æ. rùbra* var. *hùmilis*, Loud.). Low shrub, sometimes prostrate, 2–4 ft.: lfts. coarsely and unequally serrate, slightly pubescent beneath, chiefly along the veins: fls. red; calyx dark red. B.R. 1018. Var. **atrosanguínea,** Rehd. Fls. very dark red. Var. **sublaciniàta,** Wats. (*Pàvia atropurpùrea*, Spach). Lfts. narrrower oblong, deeply serrate: fls. dark red. W.D.B. 2:120. There are also forms with variegated lvs.

DD. *Lvs. tomentose or densely pubescent beneath.*

14. **díscolor,** Pursh (*Æ. Pàvia* var. *discolor*, Torr. & Gray. *Æ. octándra* var. *hýbrida*, Sarg., partly). Shrub or small tree, to 30 ft.: lfts. 5, elliptic to oblong-obovate, acuminate, finely crenately serrate, whitish tomentose beneath: panicles 6–8 in. long, rather narrow; fls. 1¼ in. long; calyx tubular, deep scarlet like the axis of the panicle; petals very unequal, scarlet and yellow in the typical form; stamens at least longer than the shorter pair of petals: fr. smooth; seeds light yellowish brown. May, June. Ga. to Texas and S. Mo. B.R. 4:310. S.S. 13:622. S.O.B. 1:39 (as *Æ. Pavia*). Var. **móllis,** Sarg. (*Æ. móllis*, Raf. *Æ. austrìna*, Small). Fls. deep scarlet. A very handsome variety with its long and rather slender racemes of bright scarlet fls. It has proved hardy at the Arnold Arboretum. Var. **flavéscens,** Sarg. Fls. yellow. This is the yellow-fld. Texan buckeye formerly referred to *Æ. octandra*.

15. **spléndens,** Sarg. A shrub, 8–12 ft.: lfts. 5, lanceolate to oblanceolate, acuminate, finely and often doubly crenulate-serrate, densely hoary pubescent beneath: fls. 1½ in. long in many-fld. panicles 4–8 in. long; calyx tubular, bright red; petals unequal, deep scarlet; stamens usually 7, longer or shorter than the petals: seeds dark chestnut-brown. May, June. Ala.—Apparently the handsomest in flower of all horse-chestnuts. S.F.S. 2:200.



135. Æsculus parviflora. (×⅛)

BB. *Fls. pure white, small; petals 4–5; stamens more than twice as long as the petals.* (*Macrothyrsus.*)

16. **parviflòra,** Walt. (*Æ. macrostàchya*, Michx. *Pàvia álba*, Poir.). Fig. 135. Shrub, 3–10 ft.: lfts. 5–7, elliptical or oblong-ovate, nearly sessile, finely serrate, pubescent beneath: panicles 8–16 in. long, narrow: fr. smooth. July, Aug. Southern states. B.M. 2118. Gng. 7:81. G.C. II. 8:653; III. 31: 189, 200; 45:123. Gn. 63, p. 299; 75, p. 568. M.D.G. 1897:305. Gn. M. 9:76. A.F. 24:533; 28:724 (habit); 34:190.—One of the handsomest plants for a lawn clump.

Æ. argùta, Buckl. (Æ. glabra var. arguta, Rob.). Allied to Æ. glabra. Shrub, 1–5 ft.: lfts. 7–9, lanceolate to obovate-lanceolate, sharply and often doubly serrate, pubescent beneath: fls. light yellowish green. Texas. S.T.S. 2:198.—Not in cult.; the plant that is cult. under this name is Æ. glabra var. Buckleyi.—*Æ. Bùshii*, Schneid. Supposed hybrid of Æ. glabra and discolor. Tree, to 30 ft.: lfts. oblong-obovate, finely and bluntly serrate, pubescent below: calyx pink; petals pink and yellow, glandular and villous at the margin: fr. slightly tuberculate. Ark. Hardy at the Arnold Arboretum.—*Æ. glaucéscens*, Sarg. Related to Æ. octandra. Shrub, to 10 ft. Lfts. larger, glabrous and glaucescent beneath: fls. larger: fr. smaller. Ga. S.T.S. 2:196.—*Æ. hùmilis*, Koehne, not Lodd. Related to Æ. discolor and possibly variety. Low shrub: lvs. tomentose beneath: fls. red and yellow. Of unknown origin.—*Æ. maryländica*, Booth. Supposed hybrid of Æ. glabra and octandra. Of unknown origin.—*Æ. neglécta*, Lindl. Near Æ. octandra, but petals veined with purple toward the base of the blade: the lfts. are glabrous beneath. Of unknown origin. B.R. 12:1009.—*Æ. Párryi*, Gray. Similar to A. californica. Lfts. small, obovate, canescent-tomentose beneath: calyx 5-lobed. Calif. G.F. 3:356.

ALFRED REHDER.

ÆTHEOPÁPPUS: *Centaurea.*

ÆTHIONÈMA (*aithō*, scorch, and *nema*, filament; probably referring to appearance of stamens). *Cruciferæ.* Dwarf, shrubby herbs for the hardy herbaceous border, or rockery. Less common than Iberis.

The genus differs from Iberis in having all its petals equal, and from Lepidium in having its four stamens longer, winged and toothed. Fls. various shades of pink, purple, or red, in crowded terminal racemes. W. B. Hemsley, in Gn. 9, pp. 108, 109.

Æthionemas dislike moist or stiff soil or shady places; but in light, sandy loam, on dry and sunny slopes, they are compact and branchy, and when once fairly established will last for many successive years without replanting or renewal, while, under the opposite conditions, the plants grow feeble and lanky, and may die after a year

or two. They keep fully as well as the candytufts in water, and can be cut with longer and straighter stems.

Propagation is by seeds in spring or by cuttings in summer; annual and biennial kinds by seeds.

A. *Perennial.*

coridifòlium, DC. (*Ibèris jucúnda,* Schott & Kotschy). Branches numerous, thick, 4–6 in. high: lvs. crowded, short, nerveless, linear or linear-oblong, acute or obtuse: fls. rosy lilac, smaller and later than in the next, in dense, short, rounded racemes. Chalky summits of Lebanon and Taurus. B.M. 5952.—Good for edging. *Æ. pulchellum* was sold under this name for many years.

grandiflòrum, Boiss. & Hohen. Branches 1–1½ ft., prostrate: lvs. usually longer than in *Æ. coridifolium,* more linear and more acute: fls. as large as those of *Arabis alpina,* rose-colored, in slender, elongated racemes; petals 4 times as long as the sepals. Persia. Gn. 9:108. Useful in the rock-garden.

pulchéllum, Boiss. & Huet. Similar to *Æ. coridifolium,* but more diffuse and trailing. Fls. smaller and brighter-colored; petals 2½ times as long as the sepals. Persia. Gn. 25:320.

iberídeum, Boiss. St. cespitose, ascending, rough: lvs. glaucous, bunched, oblong or linear-lanceolate, narrowly acute at the base: fls. large and showy, white, racemose, flowering from June to Sept. E. Medit. region.—Not well known in Amer.

AA. *Annual.*

cappadòcicum, Spreng. (*Æ. Buxbaùmi,* DC.). Six to 8 in.: lvs. oblong or linear-oblong, spatulate, glaucous: fls. racemose, the racemes crowded, corolla pale red. June. Orient.

Æ. diástrophis Bunge. 10 in. high: fls. pale, rosy lilac. Mts. of Armenia. GN. 63: 109.—*Æ. pérsicum,* Hort. Stout, erect, shrubby, dwarf: fls. deep rose.—Best of dwarfs. Intro. 1892, by J. W. Manning.

N. Taylor.†

ÆXTÓXICON (Greek, *aix,* goat, and *toxicon,* poison). *Euphorbiàceæ.* Trees, rarely cult. Younger parts covered with deciduous scales: lvs. alternate, simple, leathery: fls. with petals and disk, in short clusters: fr. fleshy, 1-seeded. The single species from the Chilian coast (*Æ. punctàtum,* Ruiz & Pav.), and known there as tique, palo muerto, acietunillo and olivillo, is listed once in the U. S. Dept. of Agric. inventories of seeds and plants intro.

J. B. S. Norton.

AFZÈLIA (named for Adam Afzelius, of Upsala, and once resident in Sierra Leone). *Leguminòsæ.* A small genus of unarmed trees, in Afr. and the Pacific Isls.: fls. with vexillum much exceeding calyx and clawed, the lateral and anterior petals scale-like or wanting; perfect stamens 7, staminodia 2. **A. bíjuga,** Gray. Tree: lvs. abruptly pinnate, the lfts. mostly in 2 pairs, ovate: fls. in small terminal panicles: pod oblong and flat, 5–8 in. long by 2 in. wide; seeds compressed-orbicular, 1 in. or more in diam. Described from the Fiji Isls., but apparently widely distributed in Oceanica. Apparently not cult., but it is the "ifit," used in Guam as a cabinet-wood and for general construction purposes.

AGALLÒCHA: *Excœcaria.*

AGÁLMYLA (*agalma,* ornament, and *hule,* wood; an ornament to the woods in which they grow wild). *Gesneràceæ.* A genus of 3 species of tender climbers from Java and Sumatra which may be grown in a basket like Æschynanthus (Trichosporum). Fls. in axillary bunches, the corolla 5-lobed, oblique, but scarcely 2-lipped: lvs. simple, alternate.

A. longistyla, Carr., is considered a synonym of the next, but apparently has a longer style. R.H. 1873:270.—*A. staminea,* Blume. Scarlet Root Blossom. St. rooting from the lower surface: lvs. alternate, with an abortive one opposite the base of each; petioles 4–8 in. long; blade as long, ovate, serrate: fls. in large axillary sessile fascicles of 12–14; stamens exserted. B.M. 5747. P.M. 15:73. F.S. 4:358.

N. Taylor.†

AGANÍSIA (Greek, meaning *desirable*). *Orchidàceæ.* Epiphytes grown on blocks.

Stems short, finally forming pseudobulbs, arising from a creeping rhizome: lf. 1: fls. few, in an erect raceme from the base of the pseudobulb; sepals and petals nearly alike, spreading; lateral lobes of the lip short or obsolete, the middle lobe broad, spreading, entire or 2- or 3-lobed; pollinia 4.—Species 2; natives of S. Amer. For culture and propagation, see article on Orchids.

cyànea, Reichb. (*A. tricolor,* N. E. Br. *Acacàllis cyànea,* Lindl.). Pseudobulbs ovoid, up to 2 in. long, 1- or 2-lvd.: lvs. narrowed to a short petiole, up to 6 in. long: raceme of 4–7 fls. over 2 in. wide; sepals and petals pale mauve, especially the latter; lip with a rose-purple reniform limb and a fringed claw. Brazil. Lind. 1:45.—Very rare in cult. Needs a high temp.

pulchélla, Lindl. Pseudobulbs ovoid, barely 1 in. long, 1-lvd.: lvs. 3–5 in. long, narrowed into a long petiole: raceme of 4–6 fls. about 1¼ in. broad; sepals and petals white; lip with the lower part nearly round, concave, spotted with red, the upper part larger, broadly ovate, yellow in the center. Guiana. B.R. 26:32.—Very rare in cult.

A. ionóptera, Nichols. Fls. blue, nodding, the sepals and petals tipped white, the white lip with the lateral lobes red-streaked, the middle lobe transversely oblong, with 2 red bars. Peru. B.M. 7270.

George V. Nash.

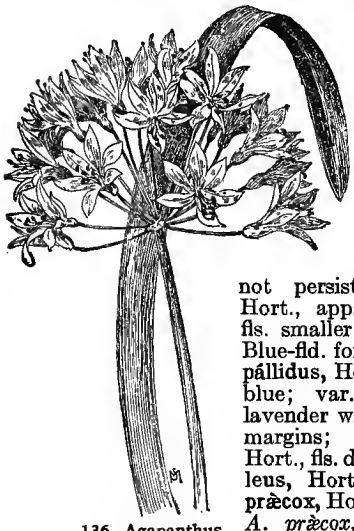
AGAPÁNTHUS (*agape,* love, and *anthos,* flower). *Liliàceæ.* Conservatory plants, with tuberous rootstocks, blooming from late spring to fall, but mostly in summer.

Plant robust and tall (dwarf forms): scape simple, fls. in 2-bracted umbels, in shades of blue and varying to white; perianth with 6 wide-spreading divisions, nearly regular; stamens 6: pod many-seeded; seeds flat, winged above: foliage usually evergreen, but vanishing early in some of the forms. S. Afr.—Probably only one species, although several have been described.

In this country, agapanthuses are usually grown in tubs (the roots are likely to burst pots), and are flowered in summer in the conservatory, window-garden, living-room, or set in protected places in the open. The plant is kept dormant during winter, as in a frame or light cellar, only enough life being maintained to prevent the leaves from falling. When in bloom, give abundance of water. Plants will bloom many years if given a large enough tub, not allowed to become overcrowded in the tub, and supplied with manure-water, sending up many clusters each year. Good results can also be obtained in single pots. It forces well. If kept dormant until spring, plants may be bedded in the open, or massed in vases, for summer bloom.—Propagation is effected by dividing the roots (and rarely by seeds). Old roots break up more easily if soaked in water a few hours. When dormant, the plant will stand a few degrees—usually 10° or less—of frost.

umbellàtus, L'Her. African Lily. Lily-of-the-Nile (although native to Cape of Good Hope region). Fig. 136. Lvs. 2 ft. long and numerous, thick, narrow: scape rising 2–3 ft. from the lf.-rosette, bearing an umbel of 10–30 handsome blue fls.; perianth funnel-shaped, 1½–2 in. long, with short tube. B.M. 500.—One of the best known of half-hardy liliaceous plants. Very variable in the wild, and many of the forms have been intro. to cult. Tall or giant forms: Var. **multiflòrus,** Voss. (var. *máximus,* Hort. *A. multiflòrus,* Willd.), taller than the prevailing forms, the bright blue large fls. as many as 30–60 in an umbel, the lvs. broader; Var. **gigantèus,** Hort., a very robust form (to 4 ft.)

with 150–200 dark blue fls. Dwarf forms: Var. **mìnor**, Hort., very small, with slender narrow lvs. (½in. or less broad) and deep blue fls. which are 1 in. or less long; var. **Mooreànus**, Hort., 1½ ft., lvs. short and upright, fls. dark blue, and as large as in *A. umbellatus* itself; hardy; var. **Leìchtlinii**, Hort., 1½ ft., fls. bright hyacinth-blue in a very compact umbel. Variegated forms: Var. **variegàtus**, Hort., lvs. white with sparse green stripes, rather small; var. **aùreus**, Hort., lvs. striped yellow. White-fld. forms: Var. **àlbidus**, Hort., fls. pure white, rather small but many, the lvs. usually not persisting; var. **Saintpaùlii**, Hort., apparently similar to last: fls. smaller than in *A. umbellatus*. Blue-fld. forms of usual habit: Var. **pàllidus**, Hort., fls. pale porcelain-blue; var. **Weìllighii**, Hort., fls. lavender with indigo-blue lines and margins; var. **Saundersoniànus**, Hort., fls. dark blue; var. **atrocærùleus**, Hort., fls. dark violet; var. **præcox**, Hort. (var. *minimus*, Lindl. *A. præcox*, Willd.), is an earlier form, blooming in June or even earlier and by some regarded as a distinct species, the lvs. narrower than in the type, fls. smaller and 30–40 in the umbel, pale blue, with narrow perianth segms., and the peduncle or scape short; var. **flòre plèno**, Hort., a double-fld. blue form, the fls. long-lasting. Very recent introductions are: Var. **globòsus** (*A. globòsus*, Bull), a dwarf-growing form, producing dense globular umbels on long scapes, the fls. about 1 in. across, the outer segms. lilac-blue shaded white and the inner ones emarginate and darker, the lvs. deciduous; var. **insìgnis** (*A. insìgnis*, Bull), tall, the basal part of the arching lvs. milk-white, the fls. very numerous on long slender pedicels and drooping in the very large umbel, pale lavender. Gn. 64, p. 67. G.M. 46, p. 423. G.W. 1903, p. 529, 531; var. **caulèscens** (*A. caulèscens*, Spreng.), fls. blue, lighter inside, long-pediceled and the outer ones nodding, the root with thickened fibers; intro. by Carl Sprenger of Naples. Gt. 50:1487. L. H. B.



136. Agapanthus umbellatus.

AGAPÈTES (Greek *agapetos*, beloved or lovable, referring to the beauty of the plant). *Ericàceæ*, subfamily *Vaccinioìdeæ*. Shrubs sometimes cultivated for their handsome flowers and attractive foliage.

Evergreen plants, often epiphytic and with the sts. thickened at the base: lvs. alternate, or irregularly whorled, short-petioled or sessile, entire or slightly toothed: fls. in axillary fascicles or short racemes, rarely solitary; calyx-tube turbinate, with 5-lobed limb; corolla tubular to campanulate, with 5, usually curved lobes; stamens 10, with short filaments, anthers produced into 2 long beaks opening at the apex by a pore or slit; ovary 5-celled, inferior: fr. a juicy or dry berry with many seeds.—About 30 species from the southern Himalayas to N. Austral., chiefly in the humid mountain forests at elevations of 3,000–6,000 ft.

The several species in cultivation are highly ornamental shrubs with handsome lustrous foliage and showy usually scarlet or bright red clustered flowers. They are sometimes grown in warm greenhouses in Europe, but apparently none of them is in the American trade.

They grow best in a porous soil consisting of peat, leaf-mold, fibrous loam and plenty of sand; the smaller kinds are suitable for growing in baskets on account of their epiphytic nature. Out-of-doors they could be grown only in warmer temperate regions, in localities in which the air possesses sufficient humidity and in partial shade.

Propagation is by cuttings of half-ripened wood under glass in the warm greenhouse.

A. buxifòlia, Nutt. Branches and calyx hairy: lvs. obovate-cuneate, crenately serrate, glabrous, about 1 in. long: fls. axillary, 1–2, cylindric, bright red with spreading lobes. Himalayas. B.M. 5012. G.C. III. 27:197.—*A. glàbra*, Clarke (Thibaudia glabra, Griff.). Glabrous: lvs. oblong-lanceolate, rounded at the base, sometimes elliptic, obscurely crenate, about 5 in. long: fls. several, axillary, tubular, ventricose below the middle, ¾in. long, white, greenish toward the apex, pink at the base. Himalayas. Gn. 10, p. 539. —*A. macrántha*, Benth. & Hook. (Thibaudia macrantha, Hook.). Plant glabrous: lvs. lanceolate, long-acuminate, 3–4 in. long: fls. in 2–3-fld. clusters, outside of the axils, pendulous, urceolate, 5-ribbed, 2 in. long, yellowish white, marked with red wavy transverse lines. E. India. B.M. 4566. F.S. 6:646. J.F. 1:95. G.C. III. 15:501. R.H. 1852:81. R.B. 26:181.—*A. Mòorei*, Hemsl. Lvs. oblong-lanceolate, usually whorled at the end of the branches, entire, glabrous, 2–3½ in. long: fls. in short axillary, 6–9-fld. racemes, cylindric, scarlet or orange-red, 1½ in. long, lobes reflexed, narrow, yellow within. Himalayas. B.M. 7928.—*A. setìgera*, D. Don (Thibaudia setigera, Wall.). Lvs. oblong or lanceolate, about 4 in. long, usually whorled: fls. in lateral clusters, deep red, usually hairy, ¾in. long; pedicels and calyx hairy. Himalayas. Wight Icon. 1180, 1181 (as Vaccinium verticillatum and V. Wallichianum).—*A. speciòsa*, Hemsl. Glabrous: lvs. ovate-oblong, subcordate at the base, slightly serrulate, 3–4 in. long: fls. 3–6, axillary, cylindric-urceolate, 5-ribbed, deep crimson, 1½ in. long. Probably from Burma. G.C. III. 41: 237.—*A. variegàta*, D. Don (Thibaudia pulcherrima, Wall. A. pulcherrima, Benth. & Hook.). Tall shrub, glabrous: lvs. elliptic-lanceolate, 6–8 in. long: fls. on the old wood in many-fld. dense clusters, cylindric-campanulate, 5-angled, pale red marked dark red, 1 in. long. Himalayas. B.M. 4303. F.S. 3, pt. 7:1–2.

ALFRED REHDER.

AGÁRICUS. A genus of fleshy fungi, considered under *Mushroom*.

AGARÍSTA: *Leptoeyne*.

AGATHÆA: *Felicia*.

ÁGATHIS (*agathis*, glome; the flowers in clusters). *Pinàceæ*. Tender Australian dicœcious conifers, allied to Araucaria, yielding dammar resin.

Leaves coriaceous, not needle-like, usually broad, petioled or almost sessile, opposite or alternate: cones axillary, ovate or globular, composed of persistent, bractless scales. Distinguished from pines and firs by the broad-parallel-veined lvs.—Not uncommon in botanic garden collections where they are grown in the temperate house.

robústa, Hook. (*Dammàra robústa*, C. Moore. *D. Brównii*, Hort.). Branches somewhat verticillate, horizontal: lvs. broad, ovate-lanceolate, obtuse, short-stalked, 3½–4 in. long, 2–3 in. wide: cones oval, 3–4 in. long, 2–3 in. wide: tree reaching 130 ft. in Austral. —Cult. in Calif.

australìs, Salisb. (*Dammàra australìs*, Lambert.). The KAWRI PINE. Tree, 120–150 ft.: lvs. sessile, linear oblong, rarely elliptic, alternate, or opposite on the branchlets, 1½–2 in. long, ½–¾in. wide: staminate catkins solitary: cones almost spherical, 2–3 in. diam. New Zeal. G.F. 2:583. Lambert, Pinus 2:44. —Cult. outdoors in Calif., but not very successfully. Kawri gum, much used in the manufacture of varnish, is the partly fossilized resin of *A. australis*. It is found 5–6 ft. below the surface of the ground, in the northern part of New Zeal., where there were vast forests of this tree in ages past.

orientàlis, Lambert. Fig. 137. Tree, 100 ft.: lvs. opposite or alternate, entire, coriaceous, glaucous, 2–4 in. long, 1½ in. wide, sometimes a little falcate: staminate catkins 2 in. long: cones globular or turbinate, solitary, peduncled, and axillary. E. Indies. Lambert, Pinus 2:43. B. M. 5359.—Cult. outdoors in Calif. and in greenhouses elsewhere. Both this and the preceding intro. by Franceschi of Santa Barbara, Calif. (as *Dammara orientalis*.)

N. TAYLOR.

AGÀVE (Greek, *agauos*, admirable). *Amaryllidàceæ*. Important decorative and economic plants from hot

VI. A good example of aquatic gardening, with water-lilies and Japanese iris.

American deserts, the most familiar of which is *A. americana*, the CENTURY PLANT, or AMERICAN ALOE.

Stem short or wanting: lvs. mostly in a close rosette, usually stiff and more or less fleshy, persisting from year to year, the margins mostly armed with teeth and the apex tipped with a usually pungent spine: fls. in spikes (Littæa) or panicles (Euagave); perianth 6-parted, more or less funnel-shaped; stamens 6, mostly long-exserted; style 1; stigma capitately 3-lobed; ovary inferior, 3-celled; seeds numerous, flat, thin, black.—Some species flower but once and die, others occasionally, while others flower from year to year. The number of species is fully 300, and more than 325 have been described, largely from the Mexican tableland, although each island of the W. Indies possesses its peculiar species. One of the largest collections is at Kew, where there are 85 named species. The largest collections in the U. S. are at the Botanical Garden of Washington and the Missouri Botanical Garden, where there are about 75 species each. Amateurs often cult. a greater number of species than are described in this account.

The most complete monographs of the genus as a whole are by General von Jacobi, in the Hamburg Garten Zeitung, 1864–1865, of which a limited number of reprints with supplements were issued in book form, and by J. G. Baker in the Gardeners' Chronicle, 1877, with excellent small illustrations, which was amplified in his Handbook of the Amaryllideæ, 1888. Several of the natural groups composing the subgenus Euagave have been monographed and illustrated in the Reports of the Missouri Botanical Garden, one of which also contains a monograph of the species known to occur in Lower California. The half-hundred West Indian species are figured and monographically treated in the eleventh volume of Memoirs of the National Academy of Sciences. Engelmann has published a monograph of the species of the United States, first classified on flower characters, in the Transactions of the Academy of Science of St. Louis, Vol. III.

Agaves are essentially fanciers' or amateurs' plants. This noble group of plants has never received the attention it deserves, and yet no genus of plants in America furnishes so many suitable decorative plants. Sir Joseph Hooker places it next to the palm and aloe, but the former is a great family of 1,100 species. While in the United States one thinks of the agaves only as decorative plants, yet in Mexico, their native home, they are the most useful of plants. Many species furnish fiber, others soap, while still others produce the two great Mexican drinks, *pulque* and *mescal*. Pulque, which is a fermented drink, is derived from several species, especially *A. atrovirens*. Mescal, which is a distilled drink, is usually not obtained from the same species as pulque, although there is a general belief to the contrary. The species from which is made most of the mescal used in Mexico is unknown.—The species vary so much in size and form that they can be used in a great many ways. Some of the smaller species are suitable for the house, and even some of the larger species are so used. The larger species are well adapted for vases in large gardens and grounds, along walks, terraces, and the like. These plants, coming, as they do, from arid or even desert regions, where they have a hard struggle to exist, can be grown with little or no care, but they respond very quickly to good treatment.—The species are propagated in various ways; some produce suckers at the base, or even underground shoots; others give off buds from the stem, which fall off and take root, or may be detached and planted; while not a few produce bulblets in the flower-clusters, and sometimes in great abundance. Nearly all may be produced from seed, but as most of the species flower only after a long interval, and many have not yet been known to flower in cultivation, this latter means of propagation cannot be relied upon. In cultivation, fruit is set very sparingly or not at all without artificial pollination, although this can be accomplished with very little trouble. (J. N. Rose.)

137. Agathis orientalis. (×⅛)

The agaves are not at all difficult to grow. The soil should be principally loam and sand, and if any vegetable soil be given it should be in small quantities. Good drainage and firm potting are necessary. To grow small plants of the large-leaved kinds into good-sized specimens quickly, they should be plunged out in a sunny spot in spring, taking care that the pots are large enough so that they will not require repotting in the fall. Nearly all of the large-growing kinds are easily increased from suckers, which, when the plants are grown in a pot-bound condition, are produced very readily. They should be taken off from the parent plant only when furnished with sufficient roots to give them a start. Some kinds are raised only from seeds, which, when freshly gathered, germinate in a few weeks. (G. W. Oliver.)

The classification of the agaves is very perplexing. This is partially owing to the number of species, to the scarcity of preserved study material, and to the infrequency of flowering in many species. In fact, many species have never been known to flower. The most usable characters for classification are to be found in the leaves, of which the end-spine and marginal prickles are very characteristic, and, although such an arrangement is more or less artificial, it is the most satisfactory in naming a collection. From a botanical point of view, however, the inflorescence shows the true relationship of the species. In this way the genus is usually divided into three groups or subgenera. These are: First, *Euagave*, having a paniculate inflorescence, with candelabra-like branches. Second, *Littæa*, having a dense spike of usually paired flowers. (The section *Littæa* has been considered by some a good genus, but it seems to connect with the first section through certain species.) The third section, *Manfreda*, is very different from the above, and is now considered as a distinct generic type, and so treated here. Manfredas are all herbaceous, appearing each year from a bulbous base: the leaves are soft and weak, dying down annually, while the inflorescence is a slender open spike, with solitary flowers from the axils of bracts.

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A. *Infl. a candelabrum-like panicle.* (*1–26.*) *Subgenus* EUAGAVE.

B. *Lvs. dagger-like or sword-shaped: spine not decurrent: fls. rather large, greenish, long-lobed, ill-smelling, often followed by bulbils; seeds very large. Trunk often developed.*

C. *Fls. urceolately contracted in throat.*

1. **angustifòlia,** Haw. (*A. lùrida,* Jacq. *A. Jacquiniàna,* Schult. f. *A. ixtlioìdes,* Hook. *A. Wrightii,* Prain. *A. vivípara,* Auct.). Short-trunked: lvs. 3 x 16–24 in., gray-green, with flat spine and slender-cusped prickles: infl. few-branched; fls. 1½–2 in.; segms. and ovary ¾in. each, tube ½in.: caps. subglobose, strongly stipitate and beaked. Cent. Amer.(?). Jacq., Obs. Bot. 4, pl. 1. Targioni Tozzetti, Ann. Firenze. 2, pl. 6. B.M. 5097, 5893. Wight, Icon. Pl. Ind. Or. 2024. Rep. Mo. Bot. Gard. 19, pl. 29–34. Proc. Amer. Phil. Soc. 49, pl. 32. Mem. Nat. Acad. 11, pl. 106–109. A form with white-margined lvs. is var. **marginàta,** Trel. (*A. vivípara variegàta* and *A. supérba,* Hort.), Wiesner Festschr., pl. 8, and a variant of this with the body color gray-green is var. **Woodròwii,** Trel. (*A. Woodròwii,* Wats., and *A. Coòkei,* Woodrow), Rep. Mo. Bot. Gard. 19, pl. 35. A dwarf form of the unvariegated type is var. **Sargentii,** Trel., Rep. Mo. Bot. Gard. 22, pl. 100–103.

2. **sisalàna,** Perr. (*A. anacántha,* Terr. *A. brèvis,* Hort. *A. Houlletiàna* or *Houlléttii,* Hort. *A. lævis,* Hort. *A. ixtli sisalàna,* Hort. *A. rígida progressàna,* Boyd. *A. rígida sisalàna,* Auct. *A. sisàla,* Perr. *A. sisalàna inérmis,* Rivière. *A. sisalàna yashquàa,* Perr.). Nearly trunkless: lvs. 4 x 60 in., becoming green, with shallow-grooved spine and typically no prickles: infl. ample; fls. 1¾–2½ in.; ovary, segm. and tube about equal: caps. rare. Yucatan or Chiapas(?). Perrine, Senate Doc. 300, pl. 1, 2, 4. Dodge, Rep. Fiber Invest. 3, 5, 9, with pl. Rep. Mo. Bot. Gard. 7, pl. 54–56. Proc. Amer. Phil. Soc. 49, pl. 32. Mem. Nat. Acad. 11. pl. 113–115.—The yaxci, green agave or sisal hemp most commonly cult. outside of Yucatan: largely distributed to growers from Trop. Fla. where Perrine intro. it about 1835 and, as in some of the W. Indies, it has become naturalized. It has been crossed by Trabut with *A. vera-cruz* under the name "potosina."

3. **fourcroỳdes,** Lem. (*A. ixtli elongàta,* Auct. *A. ixtlioìdes,* Lem. *A. longifòlia,* Auct. *A. rígida, A. rígida elongàta* and *A. rígida longifòlia* of most writers). Trunk 3–6 ft.: lvs. 3–4 x 60–90 in., gray, with round-grooved spine and slender curved prickles: infl. ample; fls. 2¼–2½ in.; ovary 1–1¼ in., segm. and tube 1¾ in. each: caps. obovoid, slightly stipitate and beaked. Yucatan. Proc. Amer. Phil. Soc. 49, pl. 32. Wiesner Festschr., 349. Mem. Nat. Acad. 11, pl. 110–112.—The sacci, gray agave or henequen, largely grown for fiber in Yucatan. A form with greenish white median variegation is var. **mèdio-pícta,** Trel.,—Wiesner Festschr., pl. 12. The shorter-lvd. but similar chelem of the Yucatan coast is **A. íxtli,** sometimes called *A. silvéstris* or *A. prolífera,* and a related plant has been called *A. mínima.* A large-lvd. poorer form of *A. fourcroydes* is known as chucumci, and a shorter-lvd. form of this as babci.

4. **decípiens,** Baker (*A. laxifòlia,* Baker. *A. latifòlia,* Auct. *A. spiràlis,* Hort.). Trunk 6–8 ft.: lvs. 2–4 x 36–50 in., green, rather soft and somewhat outcurved, with round-grooved spine and slender prickles from green prominences: infl. ample; fls. 2¼ in.; ovary 1⅛ in., segm. and tube ¾in. each: caps. pyriform. Yucatan. Dodge, Rep. Fiber Invest. 3, 5, 9, pl. Rep. Mo. Bot. Gard. 7, pl. 57–59. B.M. 7477.—The false sisal, extensively naturalized, if not indigenous, in Fla. This and *A. Karwinskii* deserve the name arborescent, in the genus Agave.

The tequila mescals (*A. tequilàna,* Web., etc.), grown in W. Mex. for the preparation of a distilled beverage, and the zapupes (*A. Zapùpe,* Trel., etc.), grown for fiber in E. Mex., are closely related to the preceding group.

CC. *Fls. slenderer, not urceolate.*

5. **Karwínskii,** Zucc. (*A. Corderoỳi,* Hort. *A. Bàkeri,* Ross). Trunk 9–12 ft.: lvs. 1–1½ x 15–30 in., green, with openly grooved spine and stout upcurved prickles: infl. rather ample; fls. 2–2¼ in.; ovary 1 in., segm. and tube about ¾in. each: caps. oblong, brown, stipitate and beaked. S. Mex. Ross, Icon. Panorm, pl. 2. Rep. Mo. Bot. Gard. 18, pl. 29–31. MacDougal, N. A. Deserts, pl. 23.

6. **macroacántha,** Zucc. (*A. macracántha,* Auct. *A. Bessereriàna,* Jacobi. *A. Besseriàna,* Auct. *A. pugioniformis,* Zucc. *A. flavéscens,* Salm. *A. subfalcàta* and *A. lineàris,* Jacobi. *A. paucifòlia* and *A. oligophýlla,* Baker. *A. integrifòlia,* Baker?). Nearly trunkless: lvs. 1 x 8–20 in., yellowish gray-green, glaucous, with flat-grooved spine and slender-cusped heavy-based prickles: infl. rather sparse; fls. 2 in.; ovary 1 in., segm. and tube ¾in. each: caps. oblong, gray, stipitate and beaked. S. Mex. Rep. Mo. Bot. Gard. 18, pl. 18–26.—At one time a great favorite and, like *A. Verschaffeltii,* collected in a large range of forms designated by descriptive varietal names: *víridis; cándida, cándicans, glaùca; nigrispina; elongàta, longifòlia; hýstrix* (B.M. 5940), *nàna; latifòlia, gigantèa, màjor, concínna* or *sudburyénsis.*

BB. *Lvs. lanceolate, large, rather firm than fleshy, scarcely repand: spine not decurrent: fls. rather large, greenish, fetid, often followed by bulbils. Nearly trunkless.*

7. **neglécta,** Small (*A. vivípara,* Bartram. *A. recurvàta* and *A. rígida recurvàta,* Hort.). Lvs. gracefully outcurved, 6 x 36 in., glaucous, with slender round-grooved spine and very minute prickles: infl. ample; fls. 2 in.; ovary 1 in., segm. ¾in., tube ½in.: caps. obovoid, scarcely stipitate or beaked. Trop. Fla. Rep. Mo. Bot. Gard. 7, pl. 60, 61. Dodge, Rep. Fiber Invest. 5, 9. ff. G.C. III. 31, supp. Feb. 1. Bartram, Travels. Map.

8. **miradorénsis,** Jacobi. Lvs. rather straight, 3–4 x 30–35 in., glaucous, with slender narrowly grooved spine and, toward the base, very minute prickles: infl. ample; fls. 2¼ in.; ovary 1 in., segm. ¾in., tube ½in. E. Mex. G.W. 5, p. 143.—*A. ananassoìdes, A. DeSmettiàna, A. pállida* and *A. Regeliàna,* not now recognized, were based by Jacobi apparently on specimens from Sartorius' ranch, El Mirador, in the state of Vera Cruz, from which, though ascribed to Brazil, *A. miradorensis* is believed to have come. All are close to if not quite the latter, over the accepted name of which *A. DeSmettiana* has priority.

9. **vèra-crùz,** Mill. (*A. bulbífera,* Bonpl. *A. Manguài,* Desf. *A. mexicàna,* Lam., which in part is *Furcræa cubénsis* and the uses of which in large part pertain to *A. atróvirens. A. vèra-crùcis,* Haw., sometimes spelled *vèræ-crùcis. A. vèra-crùx,* Mill.). Lvs. nearly straight, 6–7 x 50 in., glaucous, somewhat cross-banded, rather fleshy, concave, with short heavy gray spine and oblique rounded deltoid prickles somewhat raised on green prominences: infl. ample; fls. 2¾–3 in.; ovary 1¼–1½ in., segm. ¾–1 in., tube ¾in.: caps. oblong, prominently stipitate, scarcely beaked. Mex.(?). G.C. II. 19, p. 149.—The blue aloe, extensively planted and more or less established in Amoy, India, Mauritius and Peru, and, as *A. mexicana,* in Italy. It has been hybridized with *A. sisalana.*

10. **lùrida,** Ait. (*A. lépida,* Dietr. *A. lùcida,* Schiede). Lvs. thinner, flatter and more curving, with slenderer spine and smaller scarcely elevated prickles: infl. slighter and sparser. Mex.(?). Zuccarini, Act. Acad. Carol. Leop. 16, pt. 2, pl. 49–51. B.M. 1522(?). Ref. Bot. 307(?).—Less frequently seen than the preceding, with which it is confused. Perhaps including the now scarcely recognized *A. Beauleuriàna,* Jacobi, *A. cyànea,* Hort., *A. cyanophýlla,* Jacobi, *A. Haworthiàna,* Roem., and *A. polyphýlla,* Koch.

BBB. *Lvs. short and broad, fleshy rather than hard, repand: spine somewhat decurrent: fls. rather large, yellowish, with lobes often shorter than the tube, and followed by bulbils. Nearly trunkless.*

11. **Verschaffèltii,** Lem. Lvs. obovate-oblong, acuminate, 3 x 6–8 in., glaucous, with flexuous or twisted, flat-grooved, red-brown spine and long rusty teeth on large fleshy prominences: infl. rather slight and sparse; fls. about 2¼ in.; ovary 1¼ in., segm. ½in., tube ¾in.: caps. oblong, very stoutly stipitate, beaked. S. Mex. Ref. Bot. 306, 328. Lyon Hort. 1880, 267. Gt. 346. J. Verschaf., Cat. 1866–7, 1869. f. I. H. 15: 564.—Extremely variable, the original introducer announcing "as many varieties as there are plants," and 33 named forms having been catalogued once in the Lyon garden. The more distinct, which have received mostly descriptive specific names, are var. **crenàta** (*amèna, cochleàta, élegans*), var. **cucullàta** (*Croúcheri, Símsii*), var. **Leopôldii,** var. **pulverulénta,** var. **quadràta,** var. **Saundérsii** (*virgínica glaúca*), etc., and such minor forms as *álbida, auricántha, compácta, lanceolàta, orbiculàris, ovalifòlia, rhomboídea, rotundifòlia* and *streptacántha. A. tehuacanensis,* Karw., is the earliest published name for the species but no description was given. *A. Bonnetii,* Hort., seems to be this, but *A. Bonnetiana,* Hort., is referred to *A. mitræformis,* which accompanies *A. Verschaffeltii* about Tehuacan.—Extensively tried in hybridization, and crosses are reported with *A. attenuata* (× **A. Guignárdii**), *A. densiflora, A. micracantha* or *micrantha, A. schidigera, A. Tonelliana* or *Tonneliana* or *heteracantha Tonneliana, A. Vanderwinii,* or *Vanderwinneni* (× **A. Sìmonii** × **A. grandibracteàta**) and *A. xylonacantha* or *xylinacantha.*

12. **Scôlymus,** Karw. (*A. coccínea,* Roezl? *A. fláccida,* Jacobi?). Lvs. oblanceolate, rather acute, 3–4 x 12–15 in., green or (when it is *A. potatorum*) slightly glaucous, with nearly straight, flat-grooved, dull brown

138. Agave Franzosinii. (No. 20.)

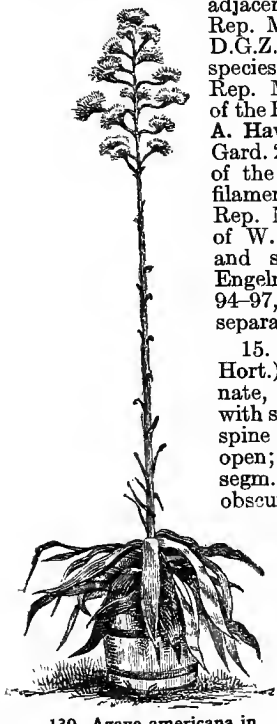
spine and small prickles on moderately low, fleshy prominences: infl. fairly large but loose; fls. 2 in.; ovary 1¼ in., segm. ½in., tube ¼in.: caps. oblong, somewhat stipitate. S. Mex. G.W. 2, p. 603.—Much of the "*coccinea*" of gardens is *A. macroculmis,* Tod., a member of the subgenus Littæa..

BBBB. *Lvs. rather oblong, very rigid, gray or glaucous, scarcely repand: spine decurrent: fls. rather large, yellow, rarely followed by bulbils. Nearly trunkless.*

13. **applanàta,** Jacobi. Lvs. lance-oblong, acute, 4–6 x 40–60 in. when mature but commonly seen of much smaller size, glaucous, with broad open gray or purplish spine and rather large more or less connected prickles: infl. 25–30 ft.; fls. 2½ in.; ovary 1¼ in., segm. ¾in., tube ½in. E. Mex. G.C. II. 7, p. 717. D.G.Z. 1903, p. 528. Tod., Hort. Pan. pl. 30. Rep. Mo. Bot. Gard. 22, pl. 73, 74.

14. **Párryi,** Engelm. (*A. applanàta Párryi,* Mulford. *A. Marcùsii,* Hort.). Lvs. oblong, acute, 2–4 x 10–12

in., glaucous, with nearly straight openly grooved spine and smaller prickles: infl. 10–15 ft.; fls. 2¼ in.; ovary 1⅛ in., segm. ½–¾in., tube ½in.: caps. oblong, beaked but scarcely stipitate. Ariz., New Mex. and adjacent Mex. G.C. II. 12, p. 237. Rep. Mo. Bot. Gard. 22, pl. 91–93. D.G.Z. 18, p. 3.—Closely related species are **A. huachucénsis**, Baker, Rep. Mo. Bot. Gard. 22, pl. 87–89, of the Huachuca Mts., with broad lvs.; **A. Havardiàna**, Trel., Rep. Mo. Bot. Gard. 22, pl. 84–86, of the great bend of the Rio Grande, with deep-seated filaments, and **A. gracílipes**, Trel., Rep. Mo. Bot. Gard. 22, pl. 98, 99, of W. Texas, with slender pedicels and small seeds, etc. **A. Couèsii**, Engelm., Rep. Mo. Bot. Gard. 22, pl. 94–97, on flowering proves scarcely separable.



139. Agave americana in flower. (No. 21.)

15. **Wislizènii**, Engelm. (*A. Nòah*, Hort.). Lvs. broadly ovate, acuminate, 4–6 x 8–10 in., gray, concave, with somewhat curved round-grooved spine and slender prickles: infl. 12 ft., open; fls. 2–2¼ in.; ovary 1¼ in., segm. ¾in., tube ½in.: caps. slender, obscurely stipitate. N. Mex. Rep. Mo. Bot. Gard. 22, pl. 75–79.—A more glaucous and repand plant from the same region is **A. parrasàna**, Berger, Rep. Mo. Bot. Gard. 22, pl. 80, 81. Thicker-lvd. related New Mex. forms are **A. chihuahuàna**, Trel., Rep. Mo. Bot. Gard. 22, pl. 82, 83, and **A. Patònii**, Trel., Rep. Mo. Bot. Gard. 22, pl. 90.

BBBBB. *Lvs. similar, somewhat repand: spine decurrent and the large teeth often confluent: fls. in compact clusters, large, yellow, not followed by bulbils. Trunk elongated but leafy.*

16. **Shâwii**, Engelm. Lvs. ovate or lance-ovate, acuminate, 3–5 x 8–20 in., green, glossy, with slender, flexuous, openly grooved spine and large, hooked, connected, garnet-red prickles: infl. 10 ft., congested; fls. 2½–3½ in.; ovary 1¼–1½ in., segm. and tube ¾in.: caps. oblong, thick-walled. S. W. Calif. and adjoining Low. Calif. Trans. Acad. St. Louis 3, pl. 2–4. Rep. Mo. Bot. Gard. 7, pl. 44; 22, pl. 19–21.—Related Low. Calif. species are **A. Orcuttiàna**, Trel., Rep. Mo. Bot. Gard. 22, pl. 22, with similar spine and **A. Sebastiàna**, Greene, Rep. Mo. Bot. Gard. 22, pl. 23–26, with straight spine; and **A. pachyacántha**, Trel., Rep. Mo. Bot. Gard. 22, pl. 27, 28, and **A. Goldmaniàna**, Trel., Rep. Mo. Bot. Gard. 22, pl. 29–31,—with heavier-based teeth and thin-walled caps. in all.

BBBBBB. *Lvs. large, fleshy rather than firm, usually repand: fls. openly panicled, large, yellow, rarely followed by bulbils. Nearly trunkless.*

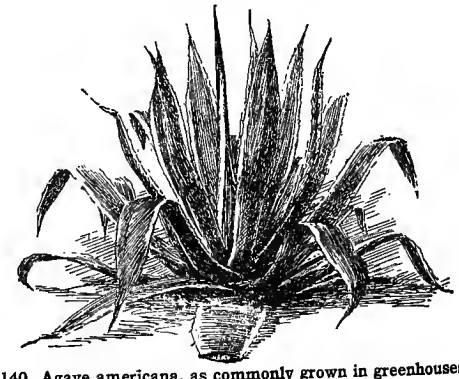
C. *Spine large and long-decurrent.*

17. **férox**, Koch. Lvs. broadly oblanceolate, wavy, suberect with outcurved concave acuminate tip, 12 x 48 in., green, deeply repand, with large grooved spine and great prickles on high green prominences: infl. 20 ft.; fls. 3¼ in.; ovary 1½ in., segm. 1 in., tube ¾in. Cent. Mex. G.C. III. 15, p. 628; III. 20, p. 525; III. 43, p. 379. G.W. 2, p. 603.

18. **mitræfórmis**, Jacobi (*A. coarctàta*, Jacobi? *A. Bonnetiàna*, Hort.?). Lvs. obovate-oblanceolate, acuminate, 12 x 30 in., grayish-zoned, rather repand, with large grooved spine and moderately large gray chestnut-tipped prickles on green prominences: infl. 15–20 ft.; fls. 2½ in.; ovary 1½–1¾ in., segm. ½in., tube ½in. S. Mex. Karsten & Schenck, Veg. Bilder, pl. 47. Anales Mus. Nac. Mex. 2, pl. j. Publ. Carnegie Inst. 99, pl. 20.—This is *A. tehuacanensis*, Koch, Karwinski's plant of that name being apparently a form of *A. Verschaffeltii*. A yellow-margined, variegated agave, listed under *A. mitræformis* by the Belgian dealers about 1876, appears to be *A. atrovirens marginata*. A cross with *A. densiflora* is said to have been effected.

19. **atròvirens**, Karw. Becoming enormous: lvs. lanceolate, 12 x 80–100 in., dark green or (when it is *A. Salmiàna*, Jacobi) gray, outcurved-ascending, with large, narrowly grooved spine and moderate gray prickles from low widened bases: infl. 20–30 ft.; fls. 3½ in.; ovary 2 in., segm. 1 in., tube ½in. S. Mex. D. Gart. Mag. 1867, p. 28., f. Contr. U. S. Nat. Herb. 5, pl. 31–33. S.H. 4, p. 281. Pop. Sci. Monthly, 70, p. 210–216. Œsterr. Gart. Zeit. 1911, p. 252. Prometheus 20, p. 24. Journ. N. Y. Bot. Gard. 8, p. 10. Modern Mex. 17, p. 26–28. Proc. U. S. Nat. Mus. 33, p. 577, etc.—The principal pulque species cultivated on the plains of Apam. Numerous varieties are figured by Segura, El Maguey, 4 ed., pl. 1–9. Vast confusion exists in current literature: the names *A. americana* and *A. mexicana* are often applied to this, and it is difficult to account elsewhere for the many new Latin names given to pulque magueys by Blasquez, and to a number of young garden plants by Jacobi. A yellow-margined variety (also listed as belonging to *A. mitræformis*) is var. **marginàta**, Trel. A very large- and concave-lvd. unvariegated form is Var. **cochleàris** (*A. latissima*, Jacobi. *A. Whitakeri*, Hort.). Other important pulque or agua-miel species are: about the City of Mexico, **A. Mapisàga**, Trel. (maguey mapisaga) with narrow small-prickled lvs.; about Durango, **A. compluviàta**, Trel. (maguey verde), with green-zoned deeply gutter-shaped lvs., and **A. quiotífera**, Trel. (maguey ceniso), with ashen lvs.; about San Luis Potosi, **A. gracilíspina**, Engelm. (*A. potosìna*, Web.), with slender spine, and **A. crassíspina**, Trel., with stout spine; and about Monterey, **A. melífflua**, Trel. (maguey manso), with elongated ashen lvs., and **A. zonàta**, Trel. (maguey verde), with broad green-zoned lvs.

20. **Franzosìnii**, Baker. Fig. 138. Lvs. lanceolate, 12 x 80–100 in., roughish, white, recurved-ascending, with large narrowly grooved spine and dark or gray prickles: infl. green, in striking contrast with the lvs.,



140. Agave americana, as commonly grown in greenhouses. The yellow-margined form. (No. 21.)

30 or 40 ft.; fls. 3½ in.; ovary 1¾ in., segm. 1 in., tube ¾in. Mex.(?). B.M. 8317. G.W. 2, p. 603. G.C. III. 12, p. 177.

CC. *Spine little if at all decurrent.*

D. *Fls. and fr. much as in the preceding. Not bulbiferous.*

21. **americàna**, Linn. (*A. altissima*, Zumag. *A. europæa*, Vis. *A. ramòsa*, Moench. *A. spectábilis*, Salisb.).

Figs. 139, 140. Lvs. lanceolate, 6–8 x 60–80 in., smooth, gray, ascending with outcurved ends, with rather short and stout recurved round-grooved very shortly decurrent spine obliquely flattened at base, and moderately large gray prickles on prominent marginal elevations: infl. 20–30 ft., rather slender; fls. 2½–2¾ in.; ovary 1¼ in., segm. 1 in., tube ½in. Mex.(?). Established around the Medit. Gt. 24:825; 27, p. 307; 41, p. 269. Penzig, Fl. Litt. Med., pl. 140. Reichb., Ic. Fl. Germ., pl. 374. B. H. 9, p. 308. R. H. 1875, p. 152. Journ. N. Y. Bot. Gard. 11, pl. 79, 81. Adamovic, Pflanzenw. Dalmat., pl. 1. Abhandl. Hamburg. Kolon. Inst. 6, p. 64. G.W. 8, p. 337. Proc. Am. Phil. Soc. 49, pl. 32.—The plant more commonly cult. in this country as *A. americana* has narrower, more hooked lvs., as in the next, but grayer and with the short recurved spine scarcely decurrent and round at base, var. **Milleri,** Baker (*A. Milleri,* Haw.? *A. virginia,* Mill.? *A. lætévirens* and *A. americàna lætévirens,* Hort.?) Variegated forms of this, frequently grown, are var. **marginàta** in yellow- or white-margined forms, var. **striàta** variously lined with yellow or white, and var. **mèdio-pícta** with a broad median yellow band. Wiesner Festschr., pl. 6. A reputed hybrid between *A. americana* and *A. densiflora* is × **A. massiliénsis,** Hort. Deleuil.

22. **pícta,** Salm-Dyck (*A. longifòlia pícta, A. mexicàna pícta,* and *A. Milleri pícta,* Hort.). Lvs. linear-lanceolate, ascending with recurved ends, at length 6–8 x 100 in., smooth, dark green with bright white or yellow marginal variegation, slightly glaucous when young, with needle-like, straight, narrowly grooved spine and moderate prickles on somewhat prominent marginal elevations: infl. tall and rather slender; fls. 3 in.; ovary 1½ in., segm. 1 in., tube ½in.: caps. oblong, stipitate and beaked. Mex.(?). G.W. 8, p. 337. Wiesner Festschr., p. 342, pl. 7. Pop. Sci. Monthly, 70, p. 210. Proc. Amer. Phil. Soc. 49, pl. 32.—Green seedlings (var. **víridis**) occur on the Riviera and are in limited cult.

DD. *Fls. rather small, yellow, shallow-tubed: caps. thin-walled, small. Not bulbiferous.*

23. **marmoràta,** Roezl (*A. Todaròi,* Baker. *A. Troubetskoyàna,* Hort. *A. undulàta,* Tod.). Lvs. broadly lanceolate, outcurving, 10–15 x 72 in., very rough, green- and gray-banded, with rather short and stout recurved narrowly grooved spine and large rough rusty brown prickles often from prominent marginal elevations: infl. ample; fls. golden, 1½ in.; ovary ¾in., segm. ½in., tube ¼in.: caps. short, stipitate. S. Mex.

DDD. *Fls. moderately long, creamy, deep-tubed: caps. firm, elongated. Not bulbiferous.*

24. **Pálmeri,** Engelm. Lvs. lanceolate, ascending, 3–4 x 18–30 in., blue-green, somewhat glaucous, with long, slender, open-grooved spine and slender, hooked garnet-purple or gray prickles, often on marginal elevations: infl. ample; fls. leathery, 2–2¼ in.; ovary 1 in., segm. ½in., tube ¾in.: caps. oblong, not stipitate. Ariz. and New Mex. Rep. Mo. Bot. Gard. 7, pl. 48–52. Journ. N. Y. Bot. Gard. 5, p. 178.

BBBBBBB. *Lvs. triangular, thick and stiff, rather small: fls. small, yellow, shallow-tubed, not followed by bulbils. Trunkless.*

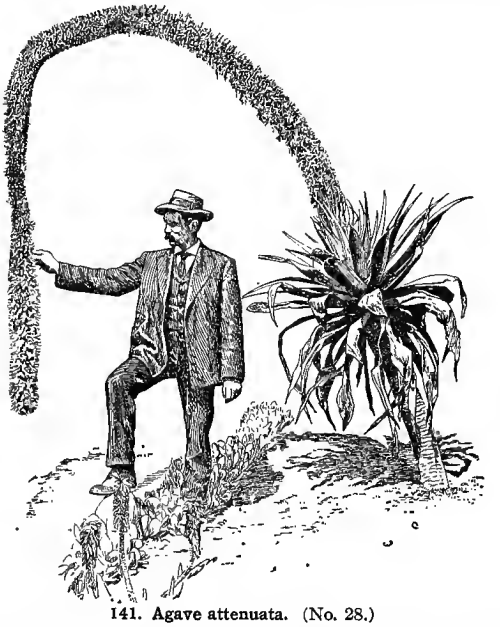
25. **desérti,** Engelm. Cespitose: lvs. triangular-lanceolate, falcately erect, 2 x 6–12 in., gray, with slender, gray-brown, grooved spine and friable teeth: infl. slender, sparse; fls. yellow, 1¼ in.; ovary flask-shaped, ½in., segm. ½in., tube ⅛in.: caps. oblong, scarcely stipitate. Colo. desert, Calif. Rep. Mo. Bot. Gard. 7, pl. 33, 34; 22, pl. 41, 42.

26. **Prínglei,** Engelm. Cespitose: lvs. triangular-oblong, ascending, 2 x 6–16 in., gray, with slender, drab, grooved spine and rather firm teeth: fls. 1½–2 in.; ovary 1–1¼ in., segm. ½in., tube ¼in. Mts. of N. Low. Calif. Rep. Mo. Bot. Gard. 22, pl. 44.

AA. *Infl. spike-like, the fls. usually in pairs though exceptionally clustered on very short branches: bulbils very rarely following the fls. (27–55.) Subgenus* LITTÆA.

B. *Lvs. triangular-lanceolate, thick and stiff, rather small: fls. often clustered on short branches, cup-shaped, small. Trunkless.*

27. **utahénsis,** Engelm. (*A. Newbérryi,* Engelm.). Cespitose: lvs. erect-spreading, 1–2 x 6–12 in., gray, with slender, grooved, gray spine and rather small and friable gray teeth: infl. 5–15 ft., with simple or forked branches 1–2 in. long; fls. 1–1¼ in.; ovary flask-shaped, ⅝in., segm. ⅜in., tube ⅛in.: caps. thin-walled,



141. Agave attenuata. (No. 28.)

small, not stipitate. Grand Cañon region. Pop. Sci. Monthly, 1911, p. 11. G.F. 8, p. 384. Rep. Mo. Bot. Gard. 7, pl. 32.

BB. *Lvs. moderately large, thin, unarmed or at most very minutely denticulate, neither filiferous nor horny-margined. Trunk well developed in the first: fls. open, rather small.*

28. **attenuàta,** Salm-Dyck (*A. glaucéscens,* Hook.). Figs. 141, 142, 143. Trunk 4–5 ft., sometimes prostrate: lvs. broadly oblanceolate, spreading, with recurved tips, 6–10 x 25–30 in., glaucous, thin, entirely unarmed: infl. 5–10 ft., usually recurving, its very short stalk closely covered by bracts; fls. paired, about 2 in.; ovary flask-shaped, ¾–1 in., segm. ¾in., tube ¼in. Exceptionally produces large bulbils among the caps. after flowering. Mex. F.E. 31, p. 1172 B. B.M. 5333. J. H. III. 42, p. 392. R.H. 1876, p. 149. Erfurter Führer. 7, p. 70. G.F. 10, p. 95. Rep. Mo. Bot. Gard. 9, pl. 31. G.C. III. 8, p. 560; III. 17, p. 455; III. 45, suppl. pl. Pharm. Journ. 70, p. 706.—Varies in a form with sterile base of spike longer and sparsely bracted, and fls. in clusters of 6–8, var. **paucibracteàta,** Rep. Mo. Bot. Gard. 11, pl. 7. The varietal names *elliptica, latifòlia, latissima* and *subundulàta* have been applied to garden forms. A cross with *A. Verschaffeltii* is × **A. Guignárdii,** Hort.; a cross with *A. xylonacantha* is listed.

29. **Ellemeetiàna,** Koch. Nearly or quite trunkless: lvs. lanceolate, spreading, 6 x 24 in. or more, glaucous, thin, unarmed: infl. 5–10 ft., erect, the rather short sterile base closely covered by linear bracts; fls. paired,

greenish white, 1¼ in.; ovary flask-shaped, ⅝in., segm. ⅝in., tube nearly suppressed; filaments very long, 2¾ in. E. Mex. G.C. II. 8, p. 748; III. 47, p. 201. B.M. 7027. Ref. Bot. 163. —With lvs. very minutely denticulate it becomes var. **subdentàta,** the distinctness of which from *A. pruinosa* is not clear. Reported crossed with *A. micracantha.*

142. Flowers of Agave attenuata.

BBB. *Lvs. moderately large, variously fleshy but usually flexible, neither filiferous nor horny-margined, teeth never large: fls. moderate, often with recurved segms. Nearly trunkless.*

C. *Spine slender and weak.*

30. **álbicans,** Jacobi (*A. micracántha albídior,* Salm-Dyck. *A. Ousselghemiàna,* Jacobi). Trunkless, cespitose: lvs. oblanceolate, 4 x 12–15 in., spreading, glaucous, thin, with small, needle-shaped, narrowly grooved spine and close-set, minute, brown prickles connected by a papery margin: infl. scarcely 3 ft., rather few-fld. above the middle; fls. paired, reddish green, nearly sessile, 1¼–1½ in; ovary ½–1 in., segm. ½in., tube ¼in.: caps. prismatic-ovoid, small. Mex.(?). B.M. 7207. Bull. Soc. Tosc. Ort. 3, p. 303. Lyon Hort. 22, p. 363. ¦With recurved long black prickles, and fls. 2¼ in. long, it is var. **ctenóphora,** Trel. A beautiful form with milk-white median variegation is var. **mèdio-pícta,** Trel. (*A. micracántha pícta, A. micracántha variegàta, A. Ousselghemiàna álba-pícta, A. Ousselghemiàna pícta,* and *A. álbicans variegàta,* Auct.), Wiesner Festschr., pl. 10. Hybrids are reported between this species and *A. maculata* and *A. xalapensis.*

31. **Célsii,** Hook. (*A. Celsiàna,* Koch. *A. densiflòra glaucophýlla,* Hort.?). Lvs. broadly oblong, 4 x 12–18 in. or more, glaucous, with slender weak spine and very irregular close-set, often multiple, prickles, fleshy except at the very tip: infl. about 4 ft., densely fld. at top; fls. reddish or yellowish green, 1½–2 in.; ovary and segm. ¾in., tube ½in.: caps. small. B.M. 4934. R.H. 1861, p. 335. Gn. 12, p. 213.—A hybrid with *A. Salmiana* is reported.

32. **micracántha,** Salm-Dyck (*A. glaucéscens,* Otto.?). Cespitose: lvs. broadly lanceolate, spreading, 3–5 x 15–25 in., grayish green, with slender weak spine and small, close-set, dark prickles: infl. about 10 ft., the rather short sterile base densely bracted; fls. brownish green, 1½ in.; ovary ½–¾ in., segm. ½ in., tube ¼ in. E. Mex.(?). Ref. Bot. 327. Gt. 37, p. 115.—Hybrids are reported with *A. Ellemeetiana, A. Sartorii, A. Verschaffeltii, A. xylonacantha* and *A. xylonacantha micracantha. A. mìtis,* Salm-Dyck, and *A. rupícola,* Regel, are closely related and *A. chloracántha,* Salm-Dyck. (*A. caribæa,* Hort.), differs chiefly in its greener lvs., with pale prickles.

CC. *Spine moderate but strong, round-grooved.*

33. **polyacántha,** Haw. (*A. abortìva,* Terr.? *A. chiapénsis,* Jacobi.? *A. chiapénsis porrécta,* Hort. *A. dénsa,* Hort.? *A. densiflòra,* Hort.? *A. multiflòra,* Hort. *A. Ottònis,* Jacobi? *A. Salmdýckii,* Baker? *A. uncinàta,* Jacobi? *A. Wolkensteìnii,* Hort.?). Cespitose: lvs. lanceolate, upcurving, 2–5 x 10–24 or 36 in., soon green, with narrow-grooved strong spine and rather small and close-set brown or gray prickles: infl. 4–5 ft.; fls. about 2 in.; ovary ¾in., segm. and tube ½in. S. Mex.(?). B.M. 5006. G.W. 2, p. 604. Journ. Soc. Hort. Bas. Rhin. 3, p. 324. Gn. 12, p. 396. R.H. 9, p. 517. G.C. II. 3, p. 502. Hybrids are reported between *A. chiapensis* and *A. xylonacantha* and *xylonacantha latissima* and with "*Dasylirion gracilis;*" *A. densiflora* and *A. americana* (× **A. massiliénsis**); *A. densiflora* and *A. geminiflora* (× **A. Táylori**),—G.C. II. 8, p. 620; *A. densiflora* and *A. mitræformis; A. densiflora* and *A. Verschaffeltii,* and *A. densiflora* and *A. xylonacantha.*

CCC. *Spine stout, openly grooved.*

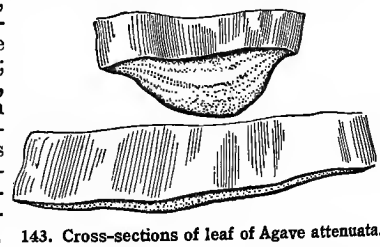
34. **Bottèrii,** Baker. Lvs. oblanceolate, outcurved-ascending, 6–8 x 24–30 in., green, with flat-grooved strong spine and short, broad, blackish close-set prickles: infl. scarcely 5 ft.; fls. reddish or yellowish green, 2 in.; ovary ¾in., segm. and tube ⅝in. each. Mex.(?). B.M. 6248. G.C. II. 8, p. 264.

35. **xalapénsis,** Roezl. Lvs. lanceolate, spreading, 2–5 x 10–30 in., nearly green to decidedly glaucous, with very openly grooved heavy spine and moderately long, heavy, rather close-set red to blackish prickles: infl. 5–10 ft.; fls. 2 in.; ovary ¾in., segm. 1 in., tube ¾in.: caps. ¾ x 1½ in., slightly constricted at base. E. Mex. Monatsschr. f. Kakteenk. 14, p. 151. R.H. 1875, p. 276. Reported hybrids are *A. xalapensis* × *filifera* (× **A. Romànii,** Hort.), *A. xalapensis* × *Ousselghemiàna, A. xalapensis* × *Salmiana,* and *A. xalapensis* × *xylonacantha* (× **A. Pfersdórffii,** Simon).

BBBB. *Lvs. fibrous and often rigid, the sometimes very large teeth connected by a detachable horny margin: fls. moderate, with soon erect segms. At most short-trunked.*

C. *Teeth rather small: lvs. elongated, rather thin but stiff.*

36. **Lechegúilla,** Torr. (*A. multilineàta,* Baker. *A. Poselgèri,* Salm. *A. tetrágona,* Hort.). Lvs. triangular-oblong, concave, falcately ascending, 1 x 16–24 in., green or bluish but not glaucous, pale-banded ventrally and dark-lined on the back, with flattened gray-brown spine and recurved slender prickles joined by a very narrow straight margin: infl. 3–12 ft., glaucous; fls. ¾–1½ in.; ovary flask-shaped, ½in., segm. ½in., tube ⅛in. W. Texas and southward, in a number of forms of which the southernmost, from below San Luis Potosi, with broader lvs. and heavier prickles, is **A. mesotíllo,** Hort. It furnishes the greater part of the ixtle or lechuguilla fiber of New Mex. usually ascribed to *A. heteracantha.* Pop. Sci. Monthly 70, p. 223. Bot. Bound. 1, pl. 34, 39. Rep. Mo. Bot. Gard. 7, pl. 31; 13. pl. 42. Bull. Univ. Texas 60, pl. 3, 6.—Closely allied forms, frequent in European gardens, are **A. cœruléscens,** Salm-Dyck (a hybrid of which with *A. Victoriæ Reginæ* is reported), differing chiefly in being very glaucous, and its var. **stenophýlla** with lvs. over 4 ft. long; **A. Funkiàna,** Koch & Bouché, with flatter, more oblong, rather glaucous lvs., which furnishes the ixtle of Jaumave; **A. Nissònii,** Baker, with thin, yucca-like, glaucous lvs.; **A. nigrés-cens** (*A. heteracántha nigréscens,* Hort.), with thick, dark blue-green, long-triangular, often undulate lvs., sometimes almost or quite unarmed on the margin, when it is the form **inérmis.**



143. Cross-sections of leaf of Agave attenuata.

37. **lophántha,** Schiede. Lvs. lanceolate, spreading, 1½–2 x 12–18 in., green, glossy, with openly grooved brown spine and variously hooked rather small prickles joined by a narrow, nearly straight margin: infl. 9–15 ft.;

fls. 1½ in.; ovary ¾in., segm. ⅝in., tube ⅛in. E. Mex. G.W. 8, p. 337. With prominent and persistent pale band on the upper face it is var. **univittàta** (*A. univittàta*, Haw. *A. ensífera*, Jacobi? *A. tæniàta*, Hort.?). Ref. Bot. 215. B.M. 6655. G.C. II, 7, p. 368. —Crosses of *A. univittata* with *A. xylonacantha* are reported, of which × **A. perbélla**, Hort., is said to be one, *A. pulchérrima*, Hort., in part, seeming to be another writing for the same.

38. **heteracántha**, Zucc. Like *A. lophantha* but lvs. somewhat sinuate and with variously hooked less equal and closer prickles. The median band is often prominent. S. Mex. G.W. 2, p. 605. G.C. II. 7, p. 369. Gt. 19, pl. 639.—Most of what is called *A. heteracantha* is *A. Lecheguilla*.

CC. *Teeth often large: lvs. either broad or thick.*

D. *Margin nearly straight.*

39. **Kerchôvei**, Lem. Lvs. triangular, spreading, 3–4 x 16–20 in., thick, gray-green, not lined beneath, with channeled gray spine and large spreading triangular teeth joined by a rather wide margin: infl. dense and heavy, 18 ft. S. Mex. G.C. II. 7, p. 527.—Formerly much grown in a number of dissimilar types: var. **Beaucárnei** (*A. Beaucárnei*, Lem., *A. Lemàirei*, Hort., *A. Kerchòvei coarctàta*, Hort.), with very short lvs.; var. **macrodónta**, with larger and more hooked teeth; var. **dístans**, with more separated teeth which have a well-developed accessory basal cusp in f. **diplacántha**, and var. **màjor**, with a short branching trunk. Related forms with shorter lvs. and slenderer, sparser infl. are **A. triangulàris**, Jacobi (*A. Kerchòvei brevifòtia*, Hort., *A. hórrida triangulàris*, Baker), Karsten & Schenck, Veg. Bilder. pl. 46, with prickles much as in *A. Kerchovei;* and its var. **rigidíssima** (*A. rigidíssima*, Jacobi), with small prickles lacking in f. **subintègra**.

40. **Rœzliàna**, Baker (*A. hórrida lævior*, Hort.). Lvs. ovate-lanceolate, spreading, 2–4 x 12–16 in., rather thick, green, broadly pale-striped above, not lined on the back, with grooved brown and then gray spine and moderately large teeth joined by a moderate margin: infl. not very heavy. S. Mex. G.C. 1871, p. 74; II. 7, p. 528. F. 1870, p. 42.—Presents as extreme forms: var. **Inghamii**, Baker (*A. Gílbéyi longifòlia*, Hort., *A. Inghami* and *A. Inghami gigantèa*, Hort.), with broad, often concolorous lvs. and large prickles, known when dwarfed as var. **Gílbeyi** (*A. Gílbeyi* and *A. hórrida Gílbéyi*, Hort.), Gt. 23, p. 89; 27, p. 84. Neubert's Gart. Mag. 50, p. 15. G.C. 1873, p. 1305; and var. **Peacóckii** (*A. Killischii*, Hort.?, *A. Peacóckii*, Croucher), B.M. 7757. G.C. 1873, p. 1400, with narrowly triangular-lanceolate lvs., sometimes entire. The names *Regeliàna, Regèlii* and *Regèlii macrodónta*, identified by Jacobi with *A. triangularis*, seem also to have been applied to this; and the now unrecognized *A. ártichaut, A. hórrida nàna* and its f. *lævior* and *A. hórrida pygmæa* of gardens may belong here. *A. Hanbùrii*, Baker, suggests a possible hybrid of this.

41. **Ghiesbréchtii**, Koch (*A. Ghiesbréghtii*, Auct. *A. grándidens*, Hort.? *A. grandidentàta*, Hort.? *A. frágilis*, Jacobi? *A. squálidens*, Hort.?). Lvs. lanceolate, 3–4 x 10–12 in., upcurved-spreading, little if at all striped, with inrolled spine and moderate prickles joined by a moderate margin. S. Mex.(?). G.C. II. 7, p. 621.—The typical clear green form varies into an equally large or longer-lvd. form with smaller, closer-set prickles, var. **Leguayàna**, Baker (*A. Leguayàna*, Hort., or, with wider margin, f. *laticíncta*), and a more compact and concave lvd., blue-green form, var. **Rohànii**, Baker (var. *obscùra*, Jacobi). A cross of *A. filifera* and *A. Ghiesbrechtii* is reported.

42. **hórrida**, Jacobi. Lvs. oblanceolate-oblong, spreading, flat, rather thin, about 3 x 12 in., glossy green, neither striped nor lined, with flat-grooved short spine and large irregular prickles often with accessory cusps, joined by a heavy margin: infl. moderately slender; fls. yellowish or purplish green, 1¾ in.; ovary and segm. ¾in. each., tube ¼in. Cent. Mex. B.M. 6511. F. 1870, p. 42.—Forms occur with larger revolute-margined lvs.: var. **Maigretiàna** (*A. Maigretiàna*, Jacobi. *A. granulòsa*, Scheidw.), G.W. 2, p. 593. S.H. 4, p. 299. G.F. 2, p. 115; or with smaller prickles, var. **micracántha**, Baker, Rep. Mo. Bot. Gard. 7, pl. 62, 63. The names *A. De Smetiàna* (*A. De Smettiàna*, Jacobi, being a form or ally of *miradorensis*), *A. Ghiesbréghtii hórrida, A. Mòrganii* and *A. Pilgrimii* have been applied in gardens to forms of this or one of the two foregoing, not now recognized.

DD. *Margin with prominent fleshy hummocks under the teeth.*

43. **xylonacántha**, Salm-Dyck, also written *xylacántha, xylinacántha* and *xylynacántha* (*A. amurénsis*, Jacobi. *A. Kòchii*, Jacobi. *A. Kòchii amurénsis*, Ellem.). Lvs. oblong, concave, tortuously spreading, 2–5 x 12–24 in., rough, dull gray-green, dark-lined beneath, with flexuous channeled gray spine and very large often multiple prickles saddling large green prominences, joined by a moderately heavy margin: infl. rather slender; fls. 1½ in.; ovary ¾in., segm. ⅝in., tube ⅛in. E. Mex. B.M. 5660. G.C. II. 7, p. 527. Lyon Hort. 1879, p. 207.—Extensively hybridized, some of its offspring recognizable in their scabrid green-lined oblong lvs. with green prominences going into the bases of the large unequal teeth: with *attenuata* or *attenuata subdentata*, *chiapensis*, *densiflora*, *filifera* (× **A. Villàrum**, Hort., × **A. Víllæ**, Pirotta, × **A. hýbrida**, Vill.), *micracantha*, *univittata* (*A. armata*, Hort.? *A. aspera*, Tod.? Terraciano, Primo Contr. pl. 3, 5, × **A. hýbrida**, Versch.), *A. xylonacantha vittata* and *A. xylonacantha hybrida* (× **A. perbélla**, *A. xylonacantha perbella*, Hort.), G.C. II. 7, p. 527, *Verschaffeltii* and *xalapensis* (× **A. Pfersdórffii**, Sim.). At one time, several varieties were listed: *cornùta* or *longifòlia*, the more typical form, *latifólia macracántha*, variously spelled, *màjor, Maximiliàna, tórta* and *Vanderdónckii*. A rare form with median variegation is var. **mèdio-pícta**.

BBBBB. *Lvs. 3-sided, short and very stiff, the detachable horny margin toothless: fls. as in the preceding. Trunkless.*

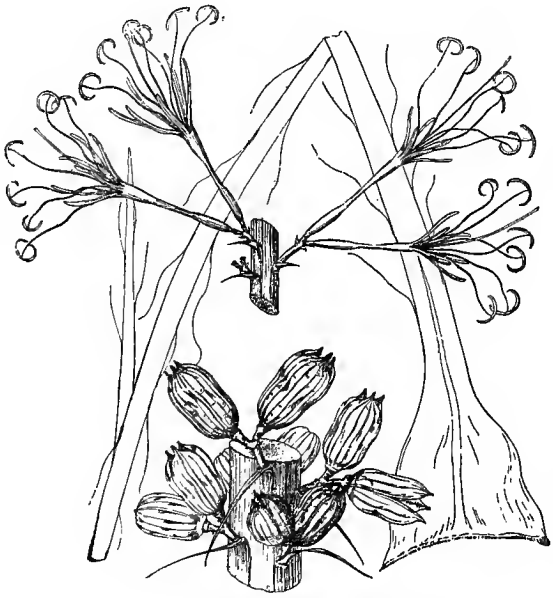
44. **Victòriæ Reginæ**, Moore (*A. Considerántii*, Duchartre). Lvs. in a globose cluster, triangular-oblong, acutely 3-angled, 1–2 x 6–8 in., dark green, with a short black triangular spine and gray margin decurrent on the edges and keel: infl. 10–12 ft., rather slender but compact; fls. 1¼ in.; ovary ⅝in., segm. ⅝in., tube ⅛in.: caps. small. N. E. Mex. G.C. 1875, p. 484; 1880, p. 788; II. 18, p. 841; III. 1, p. 806. R.H. 1875, p. 429; 1890, p. 392; 1897, p. 100. G.W. 2, p. 592; 10, p. 213. G.Z. 20, p. 88, 135. Peacock, List of Succ. Pl. pl. S.H. 4, p. 287. I. H. 28, pl. p. 413. Lyon Hort. 22, p. 371; 31, p. 146. R.B. 1876, p. 16. G.M. 6, p. 196. Gn. 8, p. 351; 22, p. 448, 460; 48, p. 117. Gt. 1878, p. 74. Journ. N. Y. Bot. Gard. 7, p. 163. —Deleuil is said to have effected a cross with *A. cærulescens*. Differing in its fewer-lvd. more open rosettes and in the triple spines at apex of the lvs. is **A. Nickélsiæ**, Hort. Both agree with the following filiferous species in having the lvs. white-marked by adherent cuticle, and with the preceding marginate species in their detachable horny border, and in fls.

BBBBBB. *Lvs. fleshy-fibrous, toothless (sometimes with minute prickles at base), the margin typically shredding away in fibers, as in Yucca: fls. nearly as in the group of A. micracantha. Trunkless.*

45. **Schóttii**, Engelm. Cespitose: lvs. linear-triangular, ¼ x 6–12 in., with scarcely grooved spine and few long slender threads: infl. 4–6 ft., slender; fls. somewhat curved, yellow, scented as in Polianthes, 1¼–1½ in.; ovary and segm. ⅜in. each, tube ⅝in.: caps. ½ x

⅝in. S. Ariz. B.M. 7567. Rep. Mo. Bot. Gard. 7, pl. 29. —With denticulate lf.-bases it is var. **serrulàta**, Mulford. Rep. Mo. Bot. Gard. 7, pl. 29. A plant approaching *A. parviflora*, from the Pinal Mts. of Ariz., with concave lvs. 2–4 in. long, fls. ⅝in. long with ovary ⅜in., segm. $\frac{3}{16}$in. and tube ½in., and ovoid caps., is **A. Toumeyàna**, Trel., Rep. Mo. Bot. Gard. 5, pl. 32; 7, pl. 30. A species of the Santa Catalina Mts., Ariz., with lvs. as in *A. Lecheguilla* but filiferous instead of marginate, and fls. nearly as in *Schottii*, is **A. Trelèasei**, Toumey, Rep. Mo. Bot. Gard. 12, pl. 31a, 32, 33.

46. **parviflòra**, Torr. Small and compact: lvs. ascending, oblong, ¼ x 2 in., with flat spine and few short coarse outcurved threads, the dilated base denticulate: infl. 2–3 ft., very slender; fls. greenish white, ⅝in.; ovary ⅜in., segm. ⅛in., tube ⅛in.: caps. very small. Ariz. to Sonora Boundary. Pop. Sci. Monthly, 1911, p. 7. Rep. Mo. Bot. Gard. 5, pl. 32, 7, pl. 30.—A similar New Mexican plant with narrowly triangular falcate lvs. and grooved spine is **A. Hartmaìni**, Wats. A less dwarf



144. Agave angustissima. (No. 48.)

plant with lvs. resembling small forms of the following but denticulate at base, sometimes cult. as *A. parviflora*, is **A. perpléxans**, Trel.

47. **filífera**, Salm-Dyck (*A. pseudofilífera*, Ross & Lanz.). Lvs. somewhat upcurved-spreading, oblong-lanceolate, 1–1½ x 8–24 in., with openly grooved spine and rather sparing thin marginal threads: infl. rather stout and dense, 10–15 ft.; fls. maroon, 1½ in.; ovary and segm. ⅝in. each, tube ½in. E. Cent. Mex. G.C. II. 7, p. 303; III. 21, p. 167. I. H. 7: 243. Lyon Hort. 1879, p. 208; 1900, p. 371; 1909, p. 147. Gt. 36, p. 544. Neubert's Gart. Mag. 39, p. 307. G.W. 6, p. 79; 1907, p. 9. Ref. Bot., 164. Rep. Mo. Bot. Gard. 11, frontisp. Icon. Sel. Hort. Thenensis, pl. 144.—Varies into a number of forms: var. **filamentòsa**, Baker (*A. filamentòsa*, Salm-Dyck, *A. filífera latifòlia, longifòlia, robústa* or *màjor*, *Bonapártea* or *Littæa filamentòsa*), G.C. 34. p. 101, with large lvs.; var. **compácta** (vars. *brevifòlia, compácta, dénsa, depauperàta* and *mìnor*, Hort.), with short broad lvs.; f. **variegàta** (*A. filífera supérba*, Hort.), in which the dingy cuticular stripes of the type (var. *viridis* or *immaculata*) are brighter and more persistent. Hybrids are reported with *geminiflora* (× **A. Táylori**), *Ghiesbrechtii, schidigera* (× **A. Leopòldii II**, *A. filifera Leopòldii*, J. H. 1893, p. 334), *xalapensis* (× **A. Romàni**) and *xylonacantha* (× **A. Villàrum**).

48. **schidígera**, Lem. (*A. filífera adornàta, A. adornàta, A. filífera pannòsa, A. filífera schidigera, A. schidígera, A. schiedígera princeps, A. princeps, Littæa Réezlii?*). Lvs. narrowly oblong, spreading, about ½ x 12 in., with flattened spine and rather wide shaving-like marginal threads. Cent. Mex. I. H. 330. B.M. 5641. G.W. 2, p. 592. S.H. 4, p. 297.—A number of closely allied forms are rather frequently mentioned or encountered in cult.: with narrow, often reddened lvs. and stalked fls., **A. Ortgiesiàna** (*A. schidígera Ortgiesiàna* and *A. marítima*, Hort.); with sessile or nearly sessile fls. and mostly very curly and numerous marginal threads, **A. angustíssima**, Engelm. (*A. Bignètii* or *Diguètii*, Hort.). Fig. 144. G.F. 6:5 (adapted in Fig. 144); **A. vestìta**, Wats., A. G. 1892, p. 609; and **A. Knightiàna**, Drum., B. R. 1145. Actes Soc. Linn. Bordeaux. 16, pl. Reported hybrids are *A. schiedigera* or *princeps* with *filifera* (× **A. Leopòldii II**) and *A. schidigera* × *Verschaffeltii*.

49. **geminiflòra**, Gawl. (*A. Bonapártea, A. Bóscii, A. geminiflòra filamentòsa, A. júncea filamentòsa, Bonapártea filamentòsa, B. flagelliformis, B. júncea, Dracæna Bóscii, D. filamentòsa, Littæa* or *Littèa* or *Littsæa geminiflòra*, and *Yúcca Bóscii*, Hort.). Lvs. very many, biconvex, long, gracefully recurving, narrowly linear, scarcely ¼in. wide, with fine marginal threads. W. Mex.(?). Occasionally found in a threadless form, var. **àtricha**. Dict. Sc. Nat. 62, pl. 55. F.S. 7, p. 6. Reichenbach, Icon. 3, pl. 209, 210. Bibl. Ital. 1816, pl. Journ. of Sci. 1817, pl. 1. G.W. 7, p. 548. Hybrids are reported with *A. densiflora* (× **A. Tàylori**, Hort. *A. geminiflora Taylori*, G.C. II. 8, p. 620. Mn. 7), and *A. filifera* (**A. Wrìghtii**, Drum., B.M. 8271.)

BBBBBBB. *Lvs. hard-fibrous, closely striate-grooved, at most scabrous margined: fls. rather small with tube and segms. about equal. Trunkless.*

50. **striàta**, Zucc. (*Bonapártea júncea rigidifòlia, B. rígida, B. rigidifòlia, B. striàta* and *B. tenuifòlia*, Hort.). Lvs. many, spreading, rhombically biconvex, ¼ x 24–36 in., gray, with needle-shaped brown spine: infl. about 10 ft.; fls. greenish, 1¼ in.; ovary ½in., protruding into the tube, segm. ½in., tube ⅜in. Cent. Mex. B.M. 4950. Gt. 29, p. 24. Jacobi, Versuch, p. 154. G.C. II. 8, p. 556. G.W. 10, p. 213. With lvs. conspicuously recurving it becomes var. **recúrva**, Baker (*A. recúrva*, Zucc.), G.C. II. 8, p. 556. Jacobi, Versuch, p. 158. **A. paucifòlia**, Tod. (*A. Roèzlii*, Hort.) differs chiefly in its fewer lvs. one-half wider, Hort. Panorm., pl. 19. The name *striata* has been applied, as a specific name, to variegated forms of *A. americana*.

51. **strícta**, Salm-Dyck (*A. hístrix* or *hýstrix, A. striàta stricta, Bonapártea hístrix, B. robústa, B. stricta, Littæa hístrix, Yúcca hístrix*, Hort.). Lvs. many, falcately upcurved in a globose cluster, triangularly biconvex, ¼ x 10–14 in., often pale or purplish, with a flattened triangular spine: infl. 5–10 ft.; fls. 1¼ in.; ovary ½in., segm. ⅜in., tube ½in. S. Cent. Mex. Jacobi, Versuch, p. 153. Gt. 31, p. 56. Gart. Mag. 40, p. 309. L. de Smet, Cat. 1874, pl.—Known in a number of forms: **purpùrea** with purplish, and **ròsea** with rosy foliage of the ordinary type; **glaùca** (*A. dealbàta hýstrix, A. hýstrix glaùca* and *glaucéscens, A. striàta glaùca, Bonapártea glaùca, B. striàta pulverulénta, Littæa dealbàta, L. glaùca*, Hort.), with long, and **nàna** (*A. dealbàta brevifòlia, compácta mìnor* and *nàna*, etc.), with short, pruinose lvs. A closely related form with flat rhombic lvs. with flatter spine, and short-tubed fls. is **A. echinoìdes**, Jacobi (*A. striàta echinoìdes, A. ensiformis?, A. hýstrix Richárdsii?, A. Richárdsii?, A. striàta Richárdsii, Dasylirion júnceum?*, Hort.). Gn. 19, p. 372.

52. **falcàta,** Engelm. Lvs. moderately numerous, falcately ascending, 3-sided, with slender 3-sided spine: infl. 3–9 ft.; fls. purplish, 1 in.; ovary ⅜in., segm. ¼in., tube ½in. N. Mex.—The "guapilla," furnishing an important part of the ixtle of N. Mex.

53. **dasylirioìdes,** Jacobi. Lvs. moderately numerous, outcurved-ascending, thin and flat, ½ x 10–12 in., pale, with flattened brown spine: infl. 5–6 ft., recurving; fls. 1½ in., ovary and segm. ⅝in. each, tube ¼–⅜ in.: caps. slender, ⅜x1 in. S. Mex. B.M. 5716. G.C. II., 8, p. 557; III. 5, p. 804. Lyon Hort. 22, p. 365. G.W. 10, p. 213.—The more glaucous form is **A. dealbàta,** Lem. (*A. dasylirioìdes dealbàta,* Baker). **A. intrépida,** Greenm., of Cent. Mex., is very similar.

BBBBBBBB. *Lvs. rather fleshy, long and narrow, unarmed or with minute soft prickles. Trunkless.*

c. *Fls. moderate, with narrow segm. and slender tube.*

54. **yuccæfòlia,** DC. (*A. Cohniàna,* Jacobi. *A. spicàta,* Guss.). Lvs. few, recurved, with minute slender spine, concave, 1x24 in., glaucous, the dry edge minutely denticulate: infl. 10 ft.; fls. 1½ in.; ovary and segm. ⅝in. each, tube ½in.: caps. ⅝ x ¾in. Mex. Redouté, Lil., pl. 328, 329. B.M. 5213. R.H. 1860, p. 519. Deutsch. Gart. Mag. 1870, 2 pl. Gn. 12, p. 583.—A very similar if distinct plant, from Jalisco, is *A. Hoùghii,* Hort., and another is *A. yuccæfòlia cæspitòsa,* Terr., Primo Contr., pl. 4.

cc. *Fls. rather small, with broad separated segms.*

55. **bracteòsa,** Wats. Lvs. sigmoidally spreading, 3-sided, gray narrowly triangular, 1½ x 20 in., spineless, minutely denticulate: infl. 3–5 ft., the scape densely covered by narrow outcurved bracts; fls. 1¼ in.: ovary ¾in.; segms. ⅝in.., tube nearly suppressed: caps. ⅜ x ¾in. N. Mex. G.C. II. 18, p. 776.

The following names occur as being in cult.: *A. Bàkeri,* Hook. f. Resembles a gigantic eremurus in habit. Fls. with pale greenish yellow segms. Mex.(?). Gn. 61, p. 240.—*A. carchariodónta.* Allied to A. Ghiesbrechtii. Lvs. flatter, narrower and more spiny. —*A. Langlàssei,* André. General habit as of Furcræa Bedinghausei. Infl. about 3 ft. high. Mex. R.H. 1901: 349.—*A. littæoìdes.* Allied to A. Scolymus. Stemless: lvs. strongly prickly toothed, terminated by a stout spine: fls. greenish yellow.—*A. Pavoliniàna.* Stemless: fls. green-yellow.—*A. Wàtsonii.* Allied to A. horrida. Distinguished by extremely narrow border of the lf. Probably Cent. Amer.—*A. Wèberi.* Distinguished by almost complete absence of marginal teeth. Mex.—*A. Wrìghtii,* J. R. Drumm. Allied to A. geminiflora. Has been cult. under name of A. Taylori. Trunk short: margins of lvs. sharp without teeth or prickles: perianth dark green with cream-white borders. Cent. Amer. B.M. 8271.

WILLIAM TRELEASE.

AGDÉSTIS (a mythical hermaphrodite monster, the genus being an anomalous one in its order). *Phytolaccàceæ.* Tender climbing shrub from Mex. and Guatemala. Cult. in Calif. at one time. A monotypic genus.

clematídea, Moc. & Sesse. Lvs. alternate, petiolate, cordate: fls. axillary or in terminal, branched, racemose cymes, white, star-shaped; sepals 4; petals 0.—Grows 40–50 ft. in one season and is covered in Sept. with masses of small white blossoms in dense racemes; very sweet-scented. The red sts. come from a tuber which grows half out of the earth, and which is sometimes 100 and 150 lbs. in weight. These tubers look like solid rocks. They are of a gray granite-color. To do its best, this plant requires very rich soil and an abundance of moisture. Small offsets appear in quantities around the old tubers and furnish good material for prop. On account of its ill-smelling fòliage, the agdestis cannot be recommended for veranda decoration; but it is a fine plant for covering unsightly objects and outhouses; to be looked for in extreme South.

N. TAYLOR.†

AGÉRATUM (Greek, *not growing old,* first applied to some everlasting). *Compósitæ.* Garden annuals.

Florets all tubular, blue (rarely pink) or white; pappus of separate or united scales; otherwise like Eupatorium.—About 30 species, mostly Trop. Am. herbs. Two in cult., with opposite, ovate, stalked and crenate-serrate lvs. and tassel-like heads in clusters. Mostly loose-growing plants, 1–2 ft. high, but with compact, dwarf, and variegated forms. Easily grown from seed in the open or started in house or hot-bed. They thrive in any garden soil, bloom all summer and, if started late, winter-blooming under glass.

conyzoìdes, Linn. Involucral scales oblong, abruptly acuminate, sparingly if at all hairy on the back, crose and ciliate: lvs. blunt or rounded at base, rarely heart-shaped. In most warm countries, often weed-like.

Houstoniànum, Mill. (*A. mexicànum,* Sims). Fig. 145. Involucral scales lance-linear, attenuate, entire, ciliate, the back finely, densely, and somewhat viscidly hairy: lvs. usually heart-shaped at base: heads slightly larger than in the last. Mex. B.M. 2524.—The better species and more frequent in cult.

145. Ageratum Houstonianum. (×½)

For so-called *A. conspícuum* and *A. Lasseàuxii,* see *Eupatòrium glechonophýllum* and *E. Lasseàuxii* respectively.

B. L. ROBINSON.

AGLÀIA (Greek, *splendor;* from the order and general appearance). *Meliàceæ.* A genus of more than 100 species of tender trees and shrubs from China, with minute, yellow, fragrant fls., said to be used in perfuming certain teas. Prop. by cuttings.

odoràta, Lour. Ten to 20 ft.: lvs. alternate, 5–7 pinnate: fls. in axillary, branching panicles. March–May. Wight. Icones. Ind. Or. 2:511. —Cult. sparingly in Calif. and under glass in botanic gardens.

AGLAONÈMA (Greek, *bright thread*). *Aràceæ.* Greenhouse herbs grown for foliage and habit.

Low plants with an erect st. and basal shoots: lvs. with a long sheathed petiole, the blade usually oblong or oblong-lanceolate, with a thick costa and few lateral nerves: peduncles in clusters, shorter than the petiole: spathe straight, convolute below, open above; spadix sessile or stalked.—About 15 species, of Trop. Asia and Afr., allied to Arum, Alocasia and Dieffenbachia, and requiring essentially the same treatment as those genera.

These plants are evergreen, often beautifully variegated. Aglaonemas may be divided, or cuttings may be taken from plants that become too tall and weak. In either case the cuttings and divisions should be put into the sand-bed previous to potting, to develop new roots. All of the kinds will succeed in fibrous loam enriched with rotted manure, with the addition of a moderate quantity of leaf-mold, sand, and some crushed charcoal. (G. W. Oliver.)

pìctum, Kunth. Dwarf: lvs. somewhat unequilateral, oblong or elliptic, ovate (4–7 in. long and 2–3 in. wide), very dark green, blotched with white, the central markings usually extending the whole length of the midrib: spathe white or whitish, 1–1½ in. long. Sumatra. I.H. 29:445.

nebulòsum, N. E. Br. Somewhat larger: lvs. narrower (5–8 in. long, 1½ in. or less wide), more acuminate, the markings rather more broken and not so continuous along the midrib. I.H. 34:24. A.G. 16:361, and

146. Aglaonema costatum. (× ⅕)

F.E. 7:961 (as *A. pictum*).—This and *A. pictum* are confused in the trade. Both species deserve more attention than they have received in this country.

costàtum, Veitch. Fig. 146. Very dwarf and compact: lvs. heart-shaped, thick, 3 in. wide, one-third longer than wide, seldom exceeding 5 in. long, dark shining green, with midrib ivory-white and scattering blotches of white. Holds its tufted lvs. through the winter. Moluccas. J.H. III. 63:225.

A. commutàtum, Schott. Lvs. oblong-lanceolate, obtuse at the base, the apex long-acuminate, intense green, marked with spots of a paler green and of white. E. Indies.—*A. Rœblinii,* Hort., is "a fine decorative plant, with thick, leathery foliage" (Manda).—*A. versícolor,* Hort. Lvs. obliquely oblong, about 4 in. long by half as wide, rounded at the base, the apex acute, irregularly marked with patches of dark velvety green interpersed with paler green and milky blotches. E. Indies.

GEORGE V. NASH.†

AGNUS-CÀSTUS: *Vitex.*

AGRIMÒNIA (old name, perhaps a corruption of *Argemone*). *Rosàceæ.* AGRIMONY. Hardy perennial herbs, natives of the north temperate zone, with alternate odd-pinnate, aromatic and astringent lvs.: fls. yellow, racemose, with 5 small petals and 5–15 stamens: fr. armed with hooked bristles.—Sometimes cult. as woodland or shrubbery plants. Not showy. Prop. by division of rootstocks in spring.

Eupatòria, Linn. (*A. officinàlis,* Lam.). COMMON AGRIMONY. Fig. 147. Petals twice as long as calyx, latter making a small, lightly adhering bur.—Cult. in herb gardens to make a tonic tea, also in wild borders. Native to Eu. Grows 2–3 ft. high, in little clumps, from a short rootstock. Has been confused with our native *A. hirsuta,* Bicknell, which is not in the trade.

odoràta, Mill. Lfts. narrower than in *A. Eupatoria,* pubescent; lobes more deeply crenate-dentate: petals more than twice as long as the calyx. Italy.—Occasionally cult. in Amer.

N. TAYLOR.†

147. Agrimonia Eupatoria. Flower and bud.

AGROPŸRON (Greek, *agros,* field, and *puros,* wheat). *Gramineæ.* WHEAT-GRASSES. Perennial grasses, often producing creeping rootstocks.

Spikelets 3- to many-fld., sessile, placed sidewise, singly and alternately on the opposite sides of a continuous rachis, forming stiff terminal spikes; glumes equal, usually firm, many-nerved, acute or awned, sometimes nearly as long as the spikelet; lemmas 5–7-nerved, usually more or less awned, the palea ciliate on the keels.—Species 30 to 40 in the temperate regions of both hemispheres. The genus differs from Triticum chiefly in being perennial, and in the entire apex of the glumes.

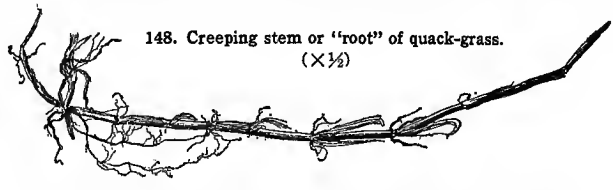
Many of the native species of the western states are important range grasses or furnish nutritious wild hay. One of these, western wheat-grass (*A. ténerum,* Vasey) (Dept. of Agric. Div. of Agrost. 17:297) has been recently introduced into cultivation and is sold by seedsmen of the northwestern states. One species, introduced from Europe, the familiar quack-grass (*A. rèpens,* Beauv., Fig. 148, also known as couch-grass, quick-grass and quitch-grass), is a troublesome weed in cultivated land, because of its long, creeping rootstocks. Though difficult to eradicate, it has value as a forage plant.

A. S. HITCHCOCK.

AGROSTÉMMA: *Lychnis.*

AGRÓSTIS (an ancient Greek name for a forage grass, from *agros,* a field). *Gramineæ.* BENT-GRASS. Annual or usually perennial grasses with erect or creeping stems and open panicles of small flowers.

Spikelets 1-fld.; glumes about equal, acute; lemma shorter and more delicate than the glumes, sometimes awned from the back, palea usually shorter than the lemma, often small or wanting.—Species about 100, distributed over the entire world, especially in the north temperate zone. The genus comprises several forage



148. Creeping stem or "root" of quack-grass. (×½)

and lawn grasses and a few ornamental, the panicles being used for bouquets. *A nebulosa* is excellent for dry bouquets. *A. elegans* of gardens is an Aira.

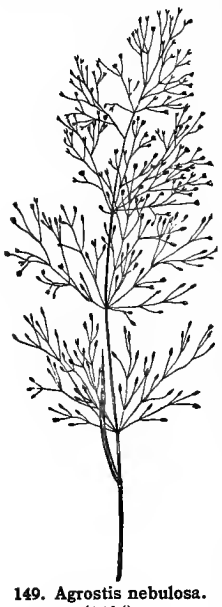
A. *Panicle open but not diffuse: perennial lawn and pasture grasses.*

B. *Palea present.*

álba, Linn. RED-TOP. HERD'S-GRASS (locally). Culms erect, 2–3 ft., from a usually decumbent base, producing short rootstocks; sheaths smooth; ligule membranaceous, 2–3 lines long; blades flat, scabrous, rather strongly nerved, acuminate-pointed; panicle oblong or pyramidal, several inches or even a foot in length; spikelets 1–1½ lines long; the glumes scabrous on the keels; lemma awnless; palea one half to two-thirds as long as the lemma. Dept. of Agric., Div. of Agrost, 17:187. Ibid. B.P.I. Bull. 68, pl. 2.—A common meadow and pasture grass, native of Eu., but abundantly escaped in the northern and central portions of the U. S. along roadsides and in waste places. Var. **vulgàris,** Thurb. FINE BENT-GRASS. RED-TOP. A more delicate grass, about 1 ft. high: panicles 1–3 in.; ligule usually 1 line or less. Dept. of Agric. B.P.I. Bull. 68, pl. 3.—This form is commonly used as a lawn grass. Var. **aristàta,** Gray. Similar to var. *vulgaris* but the lemmas bearing an exserted awn from near the base. Infrequent. Var. **marítima,** Mey. Producing long stolons; panicles narrow, contracted. Dept. of Agric. B.P.I. Bull. 68: pl. 4.—A native of the sea-coast of N. Amer. and Eu. A form of this is cult. as a lawn grass under the name of creeping bent and has received the horticultural name *Agróstis álba* var. *stolonífera,* but is not *A. stolonífera,* Linn.

BB. *Palea wanting.*

canìna, Linn. RHODE ISLAND BENT. BROWN BENT. Slender, erect, cespitose, ½–2 ft.: spikelets 1 line long; lemma bearing about the middle an exserted bent awn. Dept. of Agric. B.P.I. Bull. 68, pl. 9. Eu.—Cult. as a lawn grass, and sparingly escaped. Much of the commercial seed under this name is *Agrostis alba* var. *vulgaris*. The seed of *A. canina* may be distinguished by the absence of the palea.



149. Agrostis nebulosa. (×½)

AA. *Panicle diffuse, the main branches scabrous, long and hair-like, naked below.*

B. *Plants annual: palea present.*

nebulòsa, Boiss. & Reut. CLOUD-GRASS. Fig. 149. Culms branched below, slender, 1 ft.; blades few and small; ligule 2–3 lines; panicles oblong, about half the plant, delicate, the branches verticillate; spikelets ½ line, long-pedicelled, sometimes awned. Spain.—Cult. for dry bouquets. Sometimes called *A. capillaris* but is not *A. capillaris* of botanical authors.

BB. *Plants perennial: palea wanting.*

hiemàlis, B. S. P. (*A. scàbra,* Willd.). HAIR-GRASS. TICKLE-GRASS. SILK-GRASS. Culms low and delicate, 1–2 ft.; blades small and mostly radical; panicles very diffuse, the spikelets borne toward the extremities of the branches. Dept. of Agric. B.P.I. Bull. 68, pl. 26.—The panicles break away at maturity and are blown about by the wind. The young panicles are often used for dry bouquets.

A. minutiflòra. See Sporobolus minutiflorus.

A. S. HITCHCOCK.

AGUACATE, ALLIGATOR PEAR, AVOCADO: *Persea.*

AILÁNTHUS (from its native name *Ailanto,* meaning *Tree of Heaven*). Syn., *Pongèlion. Simarubàceæ.* Trees chiefly grown for their handsome large foliage.

Large trees: lvs. alternate, odd-pinnate, deciduous: fls. small, in large terminal panicles, polygamous; sepals and petals 5 or 6; disk small, 10-lobed; stamens 10; carpels 5 or 6: fr. consisting of 1–5 distinct oblong samaras with the compressed seed in the middle.—Eight or 9 species in Cent. and S. Asia and in N. Austral.

These trees are sparingly branched, with large pinnate foliage, inconspicuous greenish flowers in upright panicles followed by winged fruits; the foliage exhales a disagreeable odor when bruised. The ailanthus foliage gives a tropical effect when the growth is very strong.

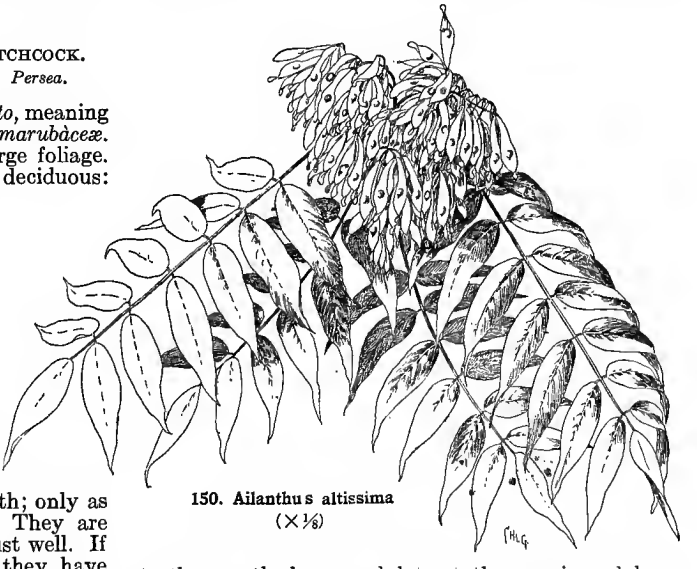
The Chinese species are fairly hardy North; only as young plants are they somewhat tender. They are very rapid growers and stand smoke and dust well. If plants are cut back to the ground after they have become established (in two or three years after planting), they will throw up very strong shoots and make an excellent screen. This practice may be repeated year after year. Sumacs, paulownias, basswoods, mulberries, and other fast-growing things may be treated in this way. The ailanthus foliage is very like that of the cedrela (which see for illustration of differences). The best known is *A. altíssima,* which is often planted as a street tree, particularly in cities, as it resists smoke better than many other trees and is not attacked by insects. For street planting, the fertile plant only should be used, because the male exhales a disagreeable odor when flowering, and the pollen is said to cause catarrhal troubles. It grows in almost any soil, but best in a light and somewhat moist one.

Propagation is by seeds which must be sown soon after ripening, and by root-cuttings. It suckers from the roots.

A. *Branchlets and petioles glabrous or only finely pubescent: lfts. glabrous beneath.*

altíssima, Swingle (*A. glandulòsa,* Desf.). TREE OF HEAVEN. Fig. 150. Tree, to 60 ft.: young branchlets minutely pubescent, usually dull yellowish brown: lvs. 1½–2 ft. long; lfts. 13–25, stalked, ovate-lanceolate, usually truncate at the base, 3–5 in. long, finely ciliate, with 8–10 pairs of veins, glabrous and glaucescent beneath, near the base with 2–4 coarse teeth, each with a large gland beneath: samaras 1½ in. long. June, July. China. G.C. III. 2:365. Gn. 24, pp. 63,65 (habit); 32, p. 330. Mn. 10, p. 152 (habit). M.D.G. 1901:324 (habit). Var. **erythrocárpa,** Rehd. (*A. erythrocárpa,* Carr. *A. rùbra,* Hort.). Lvs. darker green above and more glaucous beneath: fr. bright red, very effective in late summer and autumn. Var. **pendulifòlia,** Rehd. Lvs. very large, drooping. R.H. 1906, p. 545. Var. **sutchuenénsis,** Rehd. & Wilson (*A. sutchuenénsis,* Dode). Young branchlets reddish brown, glabrous, lustrous: petioles purplish glabrous: lfts. not ciliate, cuneate at the base, at least in older plants: fr. about 2 in. long. W. China.—In China this species and *A. Vilmoriniana* are sometimes planted as the host of a silkworm, *Attacus cynthia,* which produces a coarse silk, inferior to that of the common silkworm. As a shade and street tree, it is now much planted in temperate regions and naturalized in some localities.

Giráldii, Dode. Tree; young branchlets finely pubescent; petioles purplish: lvs. 2–3 ft. long; lfts. 33–41, closely set, lanceolate, 4–6 in. long, with 2–4 glandular



150. Ailanthus altissima (×⅛)

teeth near the base, undulate at the margin and long-pointed, with 14–15 pairs of secondary veins, dark green above, pale green beneath: panicle 8–12 in. long: fr. 2½ in. long. W. China.

AA. *Branchlets and petioles, at least in young trees, prickly and pubescent: lfts. pubescent beneath.*

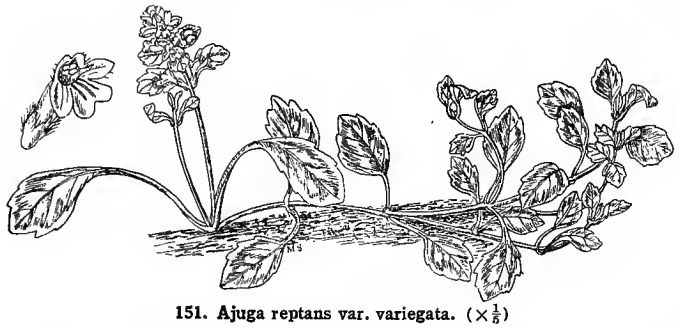
Vilmoriniàna, Dode (*Pongèlion Vilmoriniànum,* Van Tieghem. *A. altíssima* var. *spinòsa,* Bois). Tree, to 50 ft.: lvs. 2–3 ft. long; lfts. 17–35, oblong-lanceolate,

4–6 in. long, with 2–4 gland-bearing teeth near the base, glabrous or pubescent above, glaucescent and pubescent beneath: panicle to 12 in. long: fr. about 2 in. long. W. China. R.H. 1904, p. 445. Gn. 75 p. 632 (habit).—Has proved at least as hardy as *A. altíssima* at the Arnold Arboretum.

A. excélsa, Roxb. (Pongelion excelsum, Pierre). Tall tree: lvs. 3 ft. long, abruptly pinnate; lfts. 20–28, teeth without glands. India. Can be grown only in tropical regions or in the hothouse.—*A. flavéscens*, Carr.=Cedrela sinensis.

ALFRED REHDER.

AÌRA (an ancient Greek name for Darnel). *Gramíneæ.* HAIR-GRASS. Annual grasses with delicate culms and open capillary panicles. Spikelets 2–fld. one or both fls. awned from the middle of the back; palea nearly as long as the lemma.—Species 6, natives of the Medit. region, intro. in the Atlantic states and on the Pacific coast. Cult. for dry bouquets. The species have been confused by florists with Agrostis (as *Agrostis elegans*) from which genus they may be distinguished by their 2–fld. spikelets.



151. Ajuga reptans var. variegata. (×⅕)

capillàris, Host. (*A. élegans*, Willd.). Spikelets less than 1 line long, all long-pedicelled.

caryophyllèa, Linn. Pedicels mostly shorter than the spikelets. Dept. of Agric. Div. of Agrost. 7:170.

A. cæspitòsa=Deschampsia cæspitosa.—*A. fòliis variegàtis.* This name is listed in trade catalogues, but the seedsmen report that all failed. Probably is Deschampsia cæspitosa.

A. S. HITCHCOCK.

AIR-PLANT. In common speech, any plant that grows on the trunk or in the top of another plant is called an air-plant. The proper term is *epiphyte* (that is, *growing on a plant*), which see. In horticulture, the term air-plant is usually applied to epiphytal orchids, tillandsias, and the like. Most of these grow on old bark, perhaps deriving some of their nourishment from the bark, but most of it from the air and rain. Air-plants are not parasites,—they do not derive their support from the juices of the host.

The term is sometimes applied to plants that make roots from leaves or other parts that are severed and allowed to remain out of the earth. Bryophyllum is a leading example, because new plants start from the leaf-edges. The dioscoreas and rajanias that bear aërial tubers are sometimes known as air-plants. See also *Resurrection Plants.*

AJÙGA (*not yoked:* the calyx not bilabiate). *Labiàtæ.* BUGLE-WEED. Hardy herbaceous European perennials, creeping by stolons.

Height 6–12 in.: fls. numerous, in whorls, normally blue or purple, with rosy or white varieties; corolla 2-lipped, the upper lip short, the lower spreading.—Considerably used in rock-gardens and for border planting. Prop. by division in spring or by seeds.

genevénsis, Linn. (*A. rugòsa,* Hort. *A. alpìna,* Hort.). St. erect, pubescent: cauline lvs. oblong-elliptic or obovate, narrowed at the base; lower ones petiolate; floral lvs. ovate or wedge-shaped, coarsely toothed, sparsely hairy: upper fl.-whorls spicate; lower whorls distant. May, June.

pyramidàlis, Linn. St. erect: cauline lvs. obovate, hardly petiolate, in a 4-sided pyramid; floral lvs. broadly ovate, the highest often colored; all lvs. entire: fl.-whorls usually all spicate.

réptans, Linn. St. prostrate: lvs. ovate or obovate, entire or sinuate, shiny.—A low, dense, fast-spreading creeper, excellent for covering shady slopes. The typical and white-fld. forms are less cult. than the following: Var. **rùbra,** Hort. More valued for its dark purple lvs. than its blue fls. Var. **variegàta,** Hort. Fig. 151. Lvs. splashed and edged creamy yellow. Var. **atropurpùrea,** Hort. Fls. purplish blue. May.—Useful for carpeting the ground in shady places.

A. metállica var. *crispa*, Hort., intro. by Henderson, 1899, is described as dwarf (4–5 in.), with curled, metallic glossy and blue fls. in a pyramidal spike.—A bedding plant, intro. from Germany. None of the varieties are so desirable as the typical form.—*A. Bróckbanki*, Hort., "with fine blue fls.," and *A. osmáfera*, Hort., are trade names for blue-fld. bugles that are unknown in hort. or botanical literature, and it is uncertain to what species they are to be referred.

N. TAYLOR.†

AKEE: *Blighia.*

AKÈBIA (from *Akebi*, its Japanese name). *Lardizabalàceæ;* by some included in *Berberidàceæ.* Twining woody plants.

Glabrous twining shrubs: lvs. half-evergreen, long-petioled, digitate: fls. monœcious, in axillary raceme, the pistillate at the base, the staminate smaller, at the end of the raceme; sepals 3; stamens 6; carpels 3–12, with sessile stigma: fr. a large oblong berry with numerous seeds imbedded in a pulp, opening along the inner suture.—Two species with several varieties in Japan and China.

The akebias are very ornamental, hardy climbing shrubs of graceful appearance, especially adapted for places in which very dense shade is not wanted. They require a sunny position and well-drained soil; also valuable in the cool greenhouse for covering pillars and walls, growing best in a sandy compost of loam, leaf soil and peat. In Japan, the fruit which is very showy but with us rarely produced, is eaten, and the stems are much used for wicker-work.

Propagation is by seeds, by greenwood or hardwood cuttings, and also by root-division and layers.

quinàta, Decne. Figs. 152, 153. Climbing 12 ft. or more: young branchlets purplish: lfts. 5, oval or oblong-obovate, entire, emarginate, 1–2 in. long: fls. fragrant, the pistillate purplish brown, about 1 in. broad, the staminate smaller, rosy purple, in early spring: berry oblong, 3–5 in. long, dark purple with glaucous bloom; seeds black. April, May. China, Japan. B.R. 33:28. B.M. 4864. G.F. 4:137 (adapted in Fig. 153). A.G. March, 1891, figs. 5, 7, and plate. G.W. 10, p. 500. Gn. 51, p. 151. R.H. 1853:141. S.Z. 77.—Hardy, handsome, not attacked by insects or fungi. Very graceful and desirable.

152. Akebia quinata flowers.

lobàta, Decne. (*A. quercifòlia,* Sieb. & Zucc.).

Lfts. 3, broadly ovate, coarsely crenate, 1–2 in. long: fls. in long racemes, smaller than those of *A. quinata*. Japan, China. B.M. 7485. A.G. March, 1891, p. 140. G.W. 13, p. 438. S.Z. 1:78. Var. **austrâlis**, Diels. Lfts. oval or ovate to ovate-oblong, entire or nearly so, coriaceous.—Recently intro. from China and probably tender. Var. **clematifôlia**, Ito. Lfts. broadly ovate to ovate, entire, of thin texture, to 3½ in. long. Japan. A supposed hybrid of this and the preceding species is *A. pentaphŷlla*, Makino, with 3–5 lfts. entire or sparingly crenate. ALFRED REHDER.

ALÁNGIUM (from the Malabar name). Including *Márlea*. *Alangiàceæ*, formerly included in *Cornàceæ*. Trees or shrubs, rarely grown in temperate regions for their handsome large foliage and fragrant fls. A genus of over 20 species of shrubs or small trees of the Old World tropics, with alternate entire or lobed evergreen or deciduous lvs. and small, perfect whitish, often fragrant, fls. in axillary clusters; calyx small, campanulate; petals 4–10, linear, usually laxly reflexed; stamens 4–30; ovary inferior, style simple, clongated: fr. a 1-seeded drupe. Sometimes cult. in Old World gardens, either as stove plants or out-of-doors in warmer regions, but probably not in the American trade.

A. begoniifôlium, Baill. (Marlea begoniifolia, Roxbg.) Tree to 60 ft.: lvs. ovate, entire or slightly lobed, acuminate, usually rounded at base, to 8 in. long: fls. ¾in. long, in cymes; petals and atamens usually 6. Afr., S. and E. Asia. B.R. 24:61. E.P. IV. 220b, p. 3.—*A. decapétalum*, Lam. (*A. salviifolium* var. decapetalum, Wang. A. Lamarckii, Thwait.). 30 ft.: lvs. entire, oblong-lanceolate: fls. fragrant, white, solitary or in 2's or 3's in the axils; petals 10. India. E.P. IV. 220*b*, 10.—*A. platanifôlium*, Harms (Marlea platanifolia, Sieb. & Zucc.). Tree: lvs. roundish in outline, 3–5-lobed, to 8–10 in. long: fls. over 1 in. long, in few-fld. cymes, petals and stamens usually 6. Japan, China, E. P. IV. 220*b*, p. 23. This seems to be the hardiest species and is probably hardy as far north as Washington, D. C. ALFRED REHDER.

ALBÉRTA (from Albertus Grotus, commonly known as Albertus Magnus, philosopher of the thirteenth century, who wrote concerning plants). *Rubiàceæ*. Two species of shrubs or trees, one of which has been introduced as a hothouse or greenhouse subject.

Leaves thick, opposite: fls. rose-colored or purplish, in terminal panicles; calyx 10-ribbed and 5-lobed, often colored in fr.; corolla elongated-tubular.

mágna, E. Mey. Bark pale, the young branches reddish brown: lvs. 4–5 in. long, obovate-oblong, obtuse, entire, narrowed into a short, stout petiole; midrib stout: panicle terminal, erect, 6 in. high and nearly as broad at the base; corolla-tube 1 in. long, slightly swelling in upper part, pubescent; lobes 5, small, triangular, recurved. Natal. B.M. 7454. G.C. III. 22:416. Gn. 53:430. The other species is *A. minor*, Baill., from Madagascar. L. H. B.

ALBÍZZIA (after *Albizzi*, an Italian naturalist). *Leguminòsæ*. Ornamental woody plants chiefly grown for their handsome foliage and also for their attractive flowers; some are valuable timber trees; closely allied to the acacias.

Trees or shrubs: lvs. deciduous, alternate, bipinnate; lfts. usually small and numerous, oblique: fls. in axillary, peduncled spikes or globular heads; calyx tubular or campanulate, 5-toothed; corolla small, funnelform, with the segm. connate more than one-half; stamens numerous, more or less connate at the base, exserted: fr. a large strap-shaped pod without pulp.—About 25 species in tropical and subtropical regions of Asia, Afr. and Austral.; 1 in Mex.

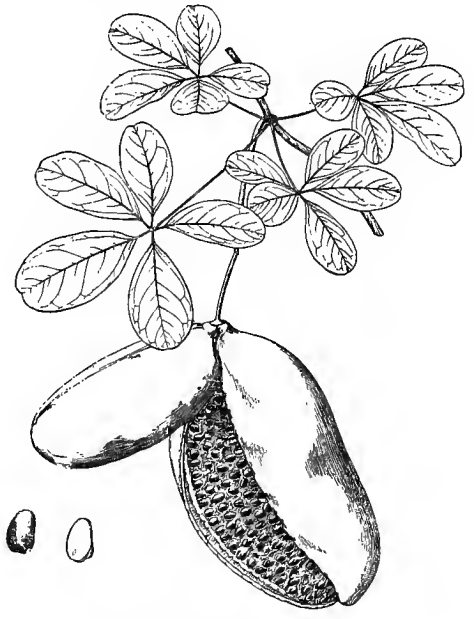
The albizzias are unarmed trees or shrubs with graceful feathery foliage and yellowish, white or pink flowers in summer. Most of the species can be grown only in subtropical and tropical regions except *A. Julibrissin* which is the hardiest species and can be grown as far north as Washington, D. C. *A. lophantha* is sometimes grown as a greenhouse shrub.

For cultivation, see *Acacia*.

A. *Fls. in cylindrical axillary spikes: lvs. sub-persistent.*

lophântha, Benth. (*Acàcia lophántha*, Willd.). Shrub or small tree, 6–20 ft.: lvs. with 14–24 pinnæ, each with 40–60 lfts., about 5 lines long, linear, obtuse: spikes mostly 2, about 2 in. long, yellowish; fls. distinctly pedicelled. S. W. Austral. B.M. 2108. B.R. 5:361. L.B.C. 8:716.—Sometimes cult. as greenhouse shrub and flowering in spring, and in the open in the S.; it has become naturalized in S. Calif. Often known as *Acacia speciosa*. There is a var. **gigantêa** in the trade.

montâna, Benth. Small tree; ferrugineously villous: lvs. with 14–24 pinnæ, each with 40–80 lfts. linear-



153. Akebia quinata fruit. (×⅓)

oblong, 3–4 lines long, obtuse: spikes cylindric, 2–3 in. long; fls. very short-pedicelled. Java.—Closely related to the preceding species, differing chiefly in its yellowish pubescence and in the short-stalked fls.

AA. *Fls. in globular heads: lvs. deciduous.*

B. *Stamens united only at the base.*

C. *Lfts. ovate or oblong, obtuse.*

D. *The fls. pedicelled, in axillary heads.*

Lébbek, Benth. (*Acàcia Lébbek*, Willd. *A. speciòsa*, Willd.). LEBBECK TREE. SIRIS TREE. WOMAN'S-TONGUE TREE. Fig. 154. Tall tree: lvs. with 4–8 pinnæ, each with 10–18 lfts., obliquely oblong or oval, 1–1½ in. long, nearly sessile: fls. greenish yellow, in short-peduncled, axillary heads, 3–4 together. Trop. Asia, N. Austral.—Planted as a yard tree in American tropics.

occidentàlis, Brandegee. Small tree, 15–25 ft.: lvs. with 8 pinnæ, each with 6–10 lfts., oblique-oval, ¾–1½ in. long, glabrous: fls. yellowish, in axillary heads. June, July. Mex., Low. Calif.—Possibly only a variety of *A. Lebbek*, and not indigenous.

DD. *The fls. nearly sessile in fascicled heads forming large terminal panicles.*

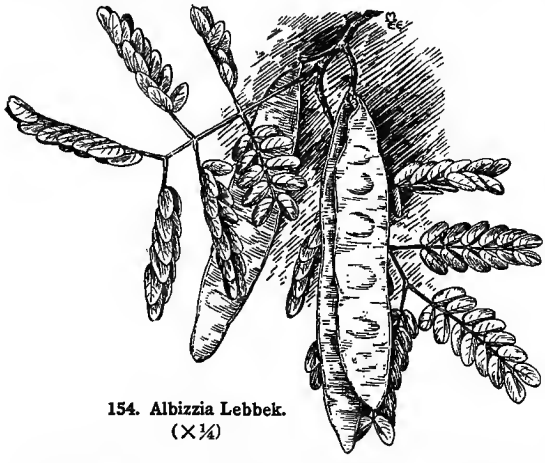
odoratíssima, Benth. (*Acàcia odoratíssima*, Willd.). Tall tree: lvs. with downy rachis; pinnæ 6–14, each with 16–50 lfts., oblique-oblong, ¾–1 in. long, glaucous beneath: heads few-fld., numerous, greenish white. E. Indies.

procĕra, Benth. (*Acàcia procèra,* Willd.). Tall tree: lvs. with nearly glabrous rachis; pinnæ 6–10, each with 12–16 lfts., oblique-oblong, 1–1½ in. long, glabrous: heads few-fld., greenish white. Trop. Asia, Austral.

cc. *Lfts. falcate, with the midrib close to the upper edge, acute.*

Julibrĭssin, Durazz. (*Acàcia Julibrissin,* Willd. *A. Nèmu,* Willd.). Tree, 30–40 ft.: rachis of the lvs. with a small gland at the base; pinnæ 8–24, with numerous lfts., falcate-oblong, ¼in. long: heads pink, slender-peduncled, crowded on the upper end of the branches. Warmer Temp. Asia from Persia to Japan. Summer., S.F. 1:51. Var. **rŏsea,** Mouillef. (*A. ròsea,* Carr.). Fls. bright pink, dwarfer and hardier than the type. R.H. 1870:490, 1912, pp. 184, 185. F.S. 21:2199.—This variety is sometimes grown under the name *A. Nemu.*

Var. **mŏllis,** Benth. (*A. móllis,* Boiss. *Acàcia móllis,* Wall.). Lfts. broader, densely pubescent. Himalayas and Abyssinia.



154. Albizzia Lebbek. (×¼)

stipulàta, Boiss. (*Acàcia stipulàta,* DC.). Tall tree: young branches with large, persistent stipules: rachis of the lvs. with many glands, pubescent; pinnæ 12–40, with numerous lfts., oblong-linear, ¼–⅓in. long, pubescent beneath: heads in axillary simple or terminal compound racemes. Trop. Asia.

BB. *Stamens connate into a long, narrow tube.*

fastigiàta, Oliver (*Zýgia fastigiàta,* E. Mey.). Tree: branches and petioles rusty-pubescent; pinnæ 8–14, each with 16–30 lfts., trapezoid-oblong, ⅓–½in. long, pubescent beneath: heads in terminal corymbs on the end of the branches. Trop. Afr.

A. moluccàna, Miq. Tree: rachis of the lvs. with many glands; pinnæ 14, each with 12–40 lfts., obliquely elliptic-oblong, glaucous and pubescent beneath. Moluccas.—Incompletely known.

ALFRED REHDER.

ALBÙCA (*whitish;* the color of the first-described species). *Liliàceæ.* Tender bulbs from the Cape of Good Hope allied to Ornithogalum, and treated in the same way.

Bulb tunicated: lvs. all radical, flat or terete: fls. large, yellow, white or green, in single racemes: perianth of 3 outer oblong more or less spreading parts and 3 inner shorter connivent segms.; stamens 6, the filaments often winged; stigma 3-lobed: fr. a 3-valved caps.—S. and Trop. Afr. and Arabia.

There are a good number of species of Albuca (about 30), but few are much known to cultivation, and none of them is apparently planted to any extent in this country. Albucas are late spring and summer bloomers, producing attractive white or yellow flowers. In mild climates, they may be carried over winter in a frame or with a good protection of litter. Propagation is by offsets or by seeds. Some of the species are hothouse plants. Allied to Urginea, to which the *A. major* of catalogues probably belongs. Numbers of hybrids have been produced.

aŭrea, Jacq. Two ft.: bracts yellow: fls. 10–30, pale yellow, upright: lvs. very narrow, flat. June.

Nélsonii, N. E. Br. Three to 5 ft.: fls. 1½ in. long, in a large cluster or spike, almond-scented, pure white with a red-brown stripe down the middle of each segm. (but pure white under glass): lvs. long, grooved or concave at base, flat above, pointed. July, Aug.—Probably the best species yet intro. The bulbs are lifted in autumn; or they may be potted up for greenhouse use. It is an excellent plant when well grown. B.M. 6649.

L. H. B.

ALCHEMĬLLA (from an Arabic name). *Rosàceæ.* Hardy herbaceous perennials, suitable for rock-gardens and front rows of borders.

Low (6–8 in.): lvs. palmately lobed or compound: fls. small, greenish or yellowish, in clusters; petals 0; stamens 1–4; pistils 1–4, becoming achenes included in the persisting calyx.—Species 30 or more in Cent. and S. Amer., Afr., India and elsewhere, largely in mountains.

Plants of easiest culture. Propagation is effected by division or by seeds. *A. arvensis* and *A. pratensis* of Europe are naturalized in North America. The *A. major* of catalogues is probably a form of one of the species.

alpīna, Bieb. Lvs. digitate, 5–7-cut; lfts. usually 7, lanceolate-cuneate, obtuse, serrate at apex, silky hairy beneath, shiny. Eu.

serĭcea, Willd. Lvs. larger than in *A. alpina,* 5–7-nerved, digitate; lfts. 7, lanceolate, acute, deeply serrate from the middle to apex, downy beneath. Caucasus.

vulgāris, Linn. (*A. montàna,* Schmidt). LADY'S MANTLE. Lvs. 7–9-nerved, 7–9-cut; reniform, plicate-concave. North temperate zone.

L. H. B.†

ALCHÓRNEA (in memory of Stanesby Alchorne). *Euphorbiàceæ.* DOVEWOOD. Tropical shrubs or trees with alternate, entire or dentate lvs.: fls. usually dicœcious, in elongated slender catkin-like infl.; staminate calyx 4-lobed; stamens 8.

One species, **A. ilicifŏlia,** Muell. Arg., is rarely grown in greenhouses, and is listed by U. S. Dept. of Agric. as intro. from Austral. It is a tall, handsome shrub with thick, holly-like lvs. The wood is useful.

J. B. S. NORTON.

ALDER: *Alnus.*

ALECTORŪRUS (Greek, apparently cock's-tail). *Liliàceæ.* An anthericum-like plant, summer-blooming and suitable for outdoor culture; hardy in England. Blooms well in pots. One species, **A. yedoënsis,** Makino, of Japan (known also as *Anthericum yedoense,* Maxim., and *Bulbinella yedoensis,* Matsum.), is now intro. to gardens. It is a perennial glabrous herb with a short and thick rootstock: lvs. 6–11, 2-ranked, 20 in. or less long: fls. many, small, pale rose, racemose along panicled branches on a scape or st. surpassing the lvs.; perianth bell-shaped, segms. 6; stamens 6, in some fls. exserted and in others only equaling the segms.; ovary 3-lobed. In Japan it is known as Keibi-ran. B.M. 8336. G.C. III. 48:352.

L. H. B.

ALÉCTRYON (Greek name for the chanticleer). *Sapindàceæ.* TITOKI. Tall trees, one of which is grown in California.

Leaves alternate, pinnate, stipulate, the lfts. entire or toothed: fls. mostly unisexual, in axillary or terminal panicles, the petals wanting, containing a small lobed disk; stamens 10 or less: fr. a hard woody caps., the seeds arillate, with spiral cotyledons.—Some 16 species in Malaya and the Pacific Isls.

excélsum, Gaertn. Evergreen, 30–60 ft., with unequally pinnate lvs. 4–12 in. long, the lfts. 4–6 pairs and 2–4 in. long, ovate-lanceolate and acuminate, nearly or quite entire: fls. greenish, in a much-branched panicle: fr. globose, woody; seed large, jet-black and shining, sunk in a large scarlet aril. New Zeal.—Said to have been in cult. in Calif. for more than 40 years and to have been sometimes sold for *Nephelium Litchi* (to which it is closely related). In New Zeal. it yields a tough elastic timber used for tools and yokes, and the natives extract oil from the seeds. L. H. B.

ÁLETRIS (Greek word for *female slave* who ground corn; alluding to apparent mealiness of the fls.). *Liliàceæ.* Hardy small herbs, sometimes grown in borders.

Leaves thin, flat, lanceolate, grass-like, in a spreading cluster, all radical: fls. small, in a spiked raceme, terminating a slender scape 2–3 ft. high; perianth not woolly, but wrinkled and roughened with many points that give a mealy appearance; perianth 6-cleft; stamens 6, inserted at the base of the lobes; style 3-cleft.—The aletrises are about 8 in number, in moors, barrens, and grassy places in N. Amer., E. Asia and Japan. They are fibrous-rooted, very bitter herbs, with fls. on a naked scape 1–2 ft. high. July, Aug. They prefer a moist but sunny situation. Prop. slowly by division; or seeds may be used. A plant once catalogued as *A. japonica* is undetermined.

farinòsa, Linn. Fls. tubular, white; lobes lanceolate-oblong. N. Amer. L.B.C. 12:1161.

aùrea, Walt. Fls. bell-shaped, fewer and shorter than in *A. farinosa,* yellow; lobes short, ovate. S. E. N. Amer. B.M. 1418 (erroneously as *A. farinosa*). L. H. B.

ALEURÌTES (Greek, *farinose* or *floury*). *Euphorbiàceæ.* Tropical trees grown for the oils they yield or sometimes for shade and ornament.

Leaves alternate, palmately veined, 3–5-lobed, the long petioles with 2 glands at the apex: fls. usually monœcious, in lax terminal cymes; sepals 2–3, valvate; petals 5; stamens 8–20, the inner row monadelphous; 1 ovule in each cell of the 2–5-celled ovary: fr. large, drupaceous, with thick-shelled seeds.—Four species, with milky juice, natives of E. Asia and Pacific Isls. Jatropha and Hevea, are related genera. Page 3565.

All of the species are cultivated in tropical countries for the drying oil derived from the seeds. These oils are similar to linseed oil, but dry quicker, harder and more waterproof but less lightproof and elastic. The seeds of *A. moluccana* yield 60 per cent of oil (kekuna, kelun or bankul oil), which is used for burning or in varnishes. The seed or oil is also used to some extent as food and the wood is worked. The tree is grown for shade. It is said to be easily grown in the tropics up to 2,000 feet altitude. It is easily propagated from seeds, which sprout in four to five weeks. The oil (wood-oil, tung-oil) of the seeds of the wood-oil trees (*A. cordata, A. Fordii*) is much used, especially in China and Japan, for treating woodwork, cloth, and the like, and for burning. Its importation to this country is on the increase, where it is used in varnishes and other products, paints, soaps, linoleum, and so on. *A. Fordii,* which is the hardier species, has been extensively introduced into the southern states by our Department of Agriculture and is reported to be doing very well.

A. cordata is a fine smooth-barked tree, good for shade and will stand high temperature, but not much below freezing. *A. Fordii* is a very ornamental tree.

The wood-oil trees are usually grown on dry, thin soil not suited to general farming. They are grown from seeds, and begin to produce nuts in three to six years. The seedlings are raised in a bed and transplanted when about a foot high or are planted where they are to stand. They may also be propagated from hardwood cuttings, which root readily. An average tree is said to yield twenty to fifty pounds of nuts with about 24 per cent of oil. The oil is pressed from the seed after roasting. The seed is poisonous. See Circ. 108, U. S. Bu. Pl. Ind.

A. *Pubescence stellate.*

moluccàna, Willd. (*A. triloba,* Forst.). Candlenut. Candleberry Tree. Varnish Tree. Tree with long spreading branches: lvs. large, ovate-acuminate, short-lobed, rusty pubescent below: paniculate cymes 4–5 in. long of many small fls.; stamens 15–20; ovary 2-celled: fr. 2–3 in. thick; seeds large, rough and walnut-like.—Probably native of Malay region but now widely cult. and wild in the tropics. In wooded valleys up to 3,000 ft. Mem. Torr. Bot. Club. 8:117. Blanco Flor. Filip. 220.—Also known as Belgaum walnut, Indian walnut, kukui and various other native names.

trispérma, Blanco (*A. saponària,* Blanco). Banucalag. Differs from *A. moluccana* in having 7–10 stamens, a 3–4-celled ovary, lvs. more entire and seeds smooth. Philippines.—Intro. once by U. S. Dept. of Agric. The seed used for the drying oil. Other native names are balocanad, baguilumbang, calumbang, balucanag. Blanco Flor. Filip, 296.

AA. *Pubescence not stellate.*

cordàta, R. Br. Japan Wood-oil Tree. Twenty-five to 30 ft. high: lvs. broadly ovate, acuminate, 3–5-lobed or toothed: petals oblong, ¾in. long, hairy at base; stamens 8–10; ovary 3–4-celled: fr. warty; seeds about the size and shape of large castor beans. S. E. Asia and adjoining isls.; cult. especially in Japan, south of 40°, and in Formosa.

Fòrdii, Hemsl. (*A. cordàta,* Muell. Arg., in part). China Wood-oil Tree. Ten to 25 ft. high: lvs. ovate-cordate: petals 1 in. or more long, orbicular ovate, somewhat hairy; stamens 8–10; ovary about 4-celled: fr. smooth: panicles of reddish white fls. in spring: fr. ripe in Sept. Cent. Asia.—Extensively cult. for the oil. Perfectly hardy in Cent. Fla. and resistant to drought. J. B. S. Norton.

ALEXANDERS. Name applied to *Smyrnium Olusatrum* (Umbelliferæ), the blanched leaf-stalks of which were once used as a salad and pot-herb, but now out of cultivation because of the superior value of celery. It is a biennial, native to Europe, with ternately dissected pinnate radical leaves, and small yellow flowers in umbels. Seed is sown in late summer or in autumn, and the plants transplanted in rows as they come up in spring. The plants are blanched by being banked with earth.

ALFÁLFA, LUCÉRNE (*Medicàgo satìva,* Linn.). A deep-rooted perennial forage plant of the *Leguminòsæ.* The plant grows one to four feet high, bears pinnate leaves with three ovate-oblong toothed leaflets, and small head-like racemes of purple clover-shaped flowers. It is native to Europe. In the arid parts of the United States it is the staple hay and forage plant, and it is also grown to a considerable extent in the East. Two to six mowings may be made each year from established meadows. Fifteen to thirty pounds of seed are sown to the acre; and the seed is preferably sown alone, without another crop. Alfalfa should not be pastured the first year. In two or three years it becomes thoroughly established and productive, and it should continue for many years. June-grass often runs it out in a cool, moist climate. Alfalfa often becomes a weed in waste places. See Cyclo. Amer. Agric. II, for full account.

ALFILARIA. Spelled also *Alfilera* which is the West American, and *Alfillarilla,* the Spanish-American for *Eròdium cicutàrium,* L'Her. *Geraniàceæ.* A hairy annual with pinnate lvs., sometimes used for pasture in dry regions. See Cyclo. Amer. Agric. II, p. 197.

ÁLGA, plural **ALGÆ.** A general name for chlorophyll-bearing thallophytes. They are flowerless plants, allied to the fungi, and generally inhabit water. Those occurring in salt water are known as seaweeds. None is cultivated. The green "moss" on flower-pots is made up of algæ.

ALGARÒBA is the fruit of *Cęratonia siliqua.*

ALHÀGI (its Mauretanian name). *Leguminòsæ.* Shrubs grown for their profusely produced red flowers.

Spiny plants: lvs. alternate, oblong, small, deciduous, entire: fls. papilionaceous, red, small, in few-fld. axillary racemes; calyx campanulate, 5-toothed; pods

155. Allamanda cathartica var. Hendersonii. (×⅓)

terete, contracted between the seeds.—Three closely related species from Greece and Egypt to the Himalayas.

These plants are low, much-branched shrubs with small and sparse, pale foliage and numerous small red flowers toward the end of the branches. Only the following species, which produces the Persian or alhagi manna, is but very rarely met with in collections. It may be cultivated in temperate regions in dry and sunny positions and propagated by seeds and by greenwood cuttings under glass with slight bottom heat; as a desert plant, it is impatient of too much moisture, and needs special attention, particularly in the seedling state.

camelòrum, Fisch. CAMEL'S THORN. Low, spiny shrub, glabrous or nearly glabrous: lvs. oblong, obtuse, ½–1¼ in. long: fls. red, about ⅓in. long, on few-fld. axillary racemes, forming panicles at the end of the branches. Summer. Caucasus to the Himalayas.—Easily distinguished by its glabrousness from the other species, which are more or less pubescent. The other species are *A. græcorum,* Boiss., *A. maurorum,* Medic.

ALFRED REHDER.

ALÍSMA (derivation doubtful). *Alismàceæ.* A genus of 2 species of hardy aquatics, with small white or pale rose fls. on scapes with whorled, panicled branches. Perennial by a stout proliferous corm. Useful in ponds. Prop. by division or seeds. According to N. Amer. Flora 17:43, 1905, the native water-plantain is not the same as the Old World species, to which, exclusively, should be applied the name here taken up for the species which has hitherto been considered cosmopolitan, and is now so treated.

Plantàgo-aquâtica, Linn. (*A. Plantàgo* of authors. *A. subcordàtum,* Raf.). WATER-PLANTAIN. Lvs. variable, but usually broadly cordate-ovate, thinner and narrower when growing under water: panicle 1–2 ft. long. Common in swales and still waters in U. S.; also in Eu. and Asia.

A. nàtans, Linn., is now referred to the monotypic genus Elisma (E. natans, Buch.). It is native to Eu., and is offered in foreign catalogues. Fl. white, single, on a long peduncle: floating lvs. elliptic and obtuse. See *Elisma.*

N. TAYLOR.†

ALKÁNNA, ÁLKANET: *Anchusa.*

ALKEKÉNGI: *Physalis.*

ALLAMÁNDA (Dr. Allamand, Leyden). *Apocynàceæ.* Tropical shrubs, mostly climbers, grown in greenhouses and conservatories, and in the open far south.

Leaves entire, whorled: fls. terminal, large and funnel-shaped, with a flat spreading or reflexed limb, the tube inflated below the throat in which there are 5 hairy scales; stamens 5, the filaments very short; ovary 1-loculed: the fr. (seldom seen in conservatories) a large spiny globular or oblong pod.—About a dozen species in Brazil and 1 in Cent. Amer.

With the exception of *A. violacea* and *A. neriifolia,* all the forms in cultivation are probably forms of one variable species. The original name for this is *A. cathartica,* and the plants known in the trade as *A. grandiflora, A. nobilis, A. Schottii, A. magnifica, A. Williamsii* are all referred to it as varieties. For garden purposes they are distinct, but botanically the differences are so slight as not to justify their being retained as species. *A. violacea* is readily distinguished by the color of the flowers, and *A. neriifolia* by the swollen base of the corolla.

The allamandas comprise several of the finest climbing plants in cultivation and are general favorites wherever grown. They are of very easy culture, thriving well under the ordinary conditions of a stove or warm greenhouse. A mixture of two parts of strong turfy loam and one part of sharp sand, leaf-mold and charcoal, suits them best. Cuttings root readily in a close case in sandy soil in a temperature of 70° F. at almost any time of the year, but spring is by far the best time, as the young plants have a long season of growth ahead of them and make better plants than those rooted later. Both old and new wood may be used for propagation; the young growth should be taken off with a heel if possible, whilst pieces of the previous season's wood, which has been well ripened, may be cut up into lengths with two or three joints, in spring; the stems which are removed during the annual pruning may be used for this purpose. All the species make most excellent pot-plants, but in order to obtain them at their best they should be planted out in a well-drained border. When well established, either in pots or borders, they should be fed liberally with natural or artificial manures, during the whole of the growing season, as all the species without exception, are gross feeders. After growth has ceased in late autumn or winter, the plants should be kept nearly, but not quite dry at the roots until February or March, when they should be cut back as far as is necessary, and started in a moist position in the greenhouse. Any repotting that they require should be done before the new growths are more than 6 inches long. The weaker kinds, as *A. violacea, A. cathartica* var. *grandiflora* and var. *Williamsii,* are best grafted on the strong-growing var. *Hendersonii.* Spring and summer.

A. *Plant bushy, or little climbing: fl. swollen at base.*

neriifòlia, Hook. A dwarf bush or half climber: sts. terete, woody below, covered with down when young: lvs. petiolate, 2–5 in a whorl, elliptic or ovate-acuminate, rich dark green above, pale dull green below, midrib and principal veins softly pilose; petiole very short: infl. short, 1–3 in. long; fls. yellow on short pale green terete stalks up to ½in. long; bracts ⅛in. long,

green; calyx spreading, lobes unequal, light green, elliptic-ovate, ⅛in. long; corolla rich golden yellow, striped inside the tube with reddish brown; tube 2 in. long, spreading upward with a swollen bulbose greenish base; limb 1½ in. diam., lobes orbicular or oval, obtuse ½in. long. Brazil. B.M. 4594.

AA. *Plant mostly tall climbing, in greenhouses usually trained on rafters: fl. not prominently enlarged at base.*

B. *Fls. purple.*

violàcea, Gardn. (*A. Blanchétii,* A. DC.). A slender-growing climber: sts. long, slender, terete, green tinted with red on side exposed to the sun, hairy: lvs. usually in 4's, almost sessile, elliptic, 4–6 in. long, dull green and covered with hispid hairs: infl. up to 1 ft. long, loosely fld.; bracts small, ¼in., lanceolate, pale green; fls. in pairs, terminating each branch of the cyme; pedicel ⅓in. long, hairy; calyx ⅔in. diam., campanulate, lobes ½in. long, elliptic-ovate, inner pair smaller than the rest, and lanceolate; corolla bright reddish purple, tube 2 in. long, narrow and constricted in the middle, upper part purple-red, middle part greenish yellow, and lower part reddish brown, limb spreading 2–2½ in. diam., lobes orbicular, throat rich dark reddish purple shading to yellowish white at the base. Brazil. B.M. 7122.—A fine handsome species, quite distinct from all other species and varieties in the color of its fls. It is a poor grower on its own roots, but thrives well when grafted on *A. cathartica* var. *Hendersonii* or var. *Schottii.*

BB. *Fls. yellow.*

cathártica, Linn. Lvs. and calyx glabrous: plant tall-climbing: lvs. rather small, obovate, usually in 4's, and more or less wavy-margined, thin, acuminate: fls. golden yellow, white-marked in the throat, the lobes acuminate on one angle, 3 in. or less across, the tube gibbous or curved. S. Amer. B.M. 338. P.M. 8:77.—The type first described, but now rarely seen in cult.

Var. **nóbilis** (*A. nóbilis,* T. Moore). A strong, tall climber, with purple twigs: lvs. and calyx more or less hairy: lvs. in 3's or 4's, large, acuminate, very short-stalked: fls. very large (4–5 in. across), nearly circular in outline of limb, bright, clear yellow, with magnolia-like odor. Finest fls. in the genus. Brazil. B.M. 5764.

Var. **Schóttii,** (*A. Schóttii,* Pohl). Strong-growing, suitable for rafters: young shoots and petioles slightly pubescent, the older sts. warty: lvs. in 3's or 4's, broadly lanceolate and acuminate: corolla large, rich yellow, the throat darker and beautifully striped. Brazil. B.M. 4351. *A. magnifica,* Hort., is a form of this.

Var. **Héndersonii** (*A. Wardleyàna,* Lebas. *A. Héndersonii,* Bull). Fig. 155. Tall and vigorous, free-flowering, excellent for roofs: glabrous: lvs. large, elliptic-ovate, thick and leathery, in 3's or 4's: fls. large, yellow-orange, with 5 light spots in the throat, the corolla of thick substance, purplish on the exterior when in bud. Gn. 29:400. I.H. 12:452.—The commonest allamanda in this country. Intro. from Guiana by Henderson & Co., St. John's Wood, England, and distributed by Bull about 1865.

Var. **grandiflòra** (*A. grandiflòra,* Hook.). St. thin and wiry: lvs. thin, ovate-lanceolate, pointed, usually in 3's: fls. somewhat smaller than those of var. *A. Hendersonii* but larger than *A. cathartica,* lemon- or primrose-yellow. Brazil. Gn: 39:192. P.M. 12:79.—Thrives well when grafted on forms of *A. cathartica.* Plant rather bushy.

Var. **Williamsii,** Hort. Habit slender, easily trained into bush form or a dwarf climber: sts. terete, slender, wiry, dull green, bright red on side exposed to the sun, covered with short hairs: lvs. elliptic shortly petiolate, usually in 3's or rarely in 4's, rich dark green above, pale dull green below, hairy on both sides, especially along the midrib on the lower side; petiole ⅓in. long, hairy: infl. rather short; fls. in pairs at each joint of the cyme; bracts much reduced, barely $\frac{1}{10}$in. long, acute; calyx erect, not spreading, sepals unequal, lanceolate, or elliptic, ⅛in. long, green; corolla yellow, tube only slightly curved 2½ in. long, narrow and stalk-like in lower half, then broadening out and becoming campanulate in upper half, upper side of the pouch suffused with reddish brown, limb spreading, 2 in. diam., lobes ovate, obtuse, ¾in. long, throat deeper shade of yellow and stained with reddish brown. Garden origin. Gn. 40:468.

L. H. B.
C. P. Raffill.

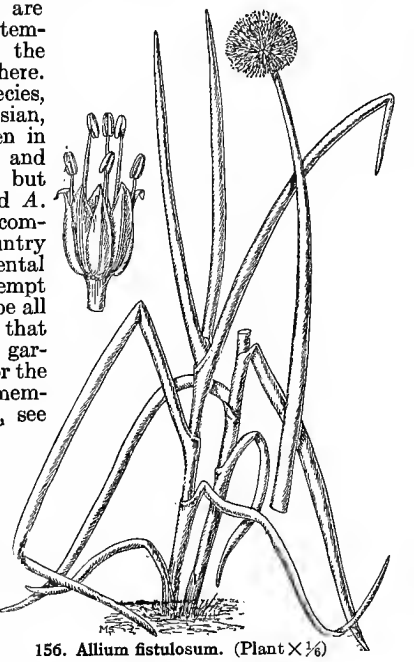
ALLEGHENY VINE: *Adlumia.*

ALL-HEAL: *Brunella vulgaris.*

ALLIGATOR PEAR, AGUACATE: *Avocado, Persea.*

ÁLLIUM (ancient Latin name of garlic). *Liliàceæ.* Bulbous plants, mostly cultivated in the open, but a few of them grown under glass as florist's flowers; and comprising also the onions and their allies.

Leaves flat, channelled, or terete and hollow: fls. in a simple umbel, from a 1–2-lvd. usually scarious spathe; stamens and perianth segms. 6, the perianth parts distinct or nearly so, 1-nerved, and often becoming dry and persistent; style slender, the stigma either entire or parted.—Strong-scented plants, with fls. white, yellow, or in shades of purple and rose. There are 250–300 species in temperate parts of the northern hemisphere. Numbers of species, particularly the Asian, are frequently seen in botanic gardens and choice collections, but only *A. Moly* and *A. neapolitanum* are common in this country among the ornamental species, and no attempt is made to describe all the species here that are mentioned in garden literature. For the vegetable garden members of the genus, see *Chives, Garlic, Leek, Onion, Shallot.* In parts of the northeastern states *Allium vineale* is a bad weed; it has a slender scape sheathed below with hollow thread-shaped lvs., and greenish rose-colored fls. (or bulblets in the place of fls.).



156. Allium fistulosum. (Plant × ⅙)

No special treatment is required by the alliums. Most of the cult. forms are hardy spring bloomers, and may be treated the same as other hardy border bulbs. Propagation is by offsets and by the bulblets in the umbel; also readily by seeds.

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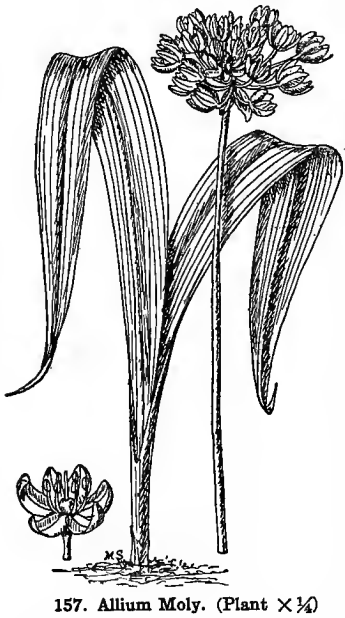
A. *Group I, comprising the vegetable-garden species.*

B. *Lvs. terete and hollow.*

C. *Plant cespitose (in tufts or clumps) and perennial.*

1. **Schœnòprasum,** Linn. CHIVES or CIVES. Lvs. 4–6 in., very many, slender and awl-shaped: scapes equaling the lvs.; fls. light purple, small and many in a globular head. Eu. —The lvs. are used for seasoning, growing readily as the herbage is cut. Var. **sibìricum,** Hartm., is a large form in northern N. Amer.



157. Allium Moly. (Plant ×¼)

CC. *Plants not in mats, treated practically as annuals (except perhaps No. 6).*

2. **Cèpa,** Linn. COMMON ONION. Tall, with large tubular lvs.: scape glaucous, much overtopping the lvs., swollen near middle; fls. white or bluish in a large globular head-like umbel: bulb not making many offsets, distinctly rounded at top and bottom. Var. **bulbellìfera,** Bailey, has bulbels in the place of fls.,—the top, tree or Egyptian onion. Var. **multiplìcans,** Bailey, has dividing bulbs,—the multiplier onion. Persia and adjacent regions.

3. **fistulòsum,** Linn. WELSH ONION. Fig. 156. Differs in having no distinct bulb, but only an enlarged base or crown: lvs. usually more clustered. Siberia. B.M. 1230.

4. **ascalònicum,** Linn. SHALLOT. Smaller, 1 ft.: lvs. many, awl-shaped: fls. lilac: bulbs long and pointed, each one soon separating into many cloves or parts adhering to a common disk. Syria.

BB. *Lvs. not hollow, more or less plane.*

5. **satìvum,** Linn. GARLIC. Plant 12 in. or less: lvs. very narrow, keeled: fls. purple, often replaced by bulbels: bulbs small, breaking up into many small ones that are more or less covered with the dry scales. Eu.

6. **Pórrum,** Linn. LEEK. Stout plant, 2 ft. or more: lvs. very broad and strongly conduplicate or keeled: scape arising the second season; fls. white or blush: bulb simple and scarcely more than an enlargement of the stalk. Eu.

AA. *Group II. The garden alliums, mostly exotic.*

B. *Fls. yellow.*

7. **Mòly,** Linn. Fig. 157. Lvs. flat, broad: fls. numerous, in a dense umbel, in early spring. S. Eu. B.M. 499.—Well known, and a favorite for massing; common in rock-gardens. Hardy in the N.

BB. *Fls. white or whitish.*

C. *Lvs. very broad, obtuse.*

8. **victoriàlis,** Linn. Tall: lvs. ovate or broad-oblong, short: fls. greenish white, in large heads. Spring. Siberia. B.M. 1222.—Hardy.

CC. *Lvs. narrow, acute or tapering.*

9. **neapolitànum,** Cyr. Fig. 158. Lvs. long and rather narrow, loose-spreading, shorter than the scape: fls. large, pure white, with colored stamens on long pedicels. Eu.—Needs protection if grown outdoors. Much used for cut-flowers in winter and spring. The most popular species. *A. Herméttii grandiflòrum,* recently intro. from Holland, is a clear white odorous variety, well adapted to forcing.

BBB. *Fls. pink, rose, or lilac.*

C. *Segms. with recurved tips.*

10. **acuminàtum,** Hook. Scape 4–10 in.: lvs. 2–4, not longer than the scape, very narrow: umbel many-fld.; perianth segms. a third longer than the stamens, the inner ones serrulate. W. Amer.

CC. *Segms. not recurved.*

11. **ròseum,** Linn. Scape 12–18 in.: lvs. narrow, with inrolled tips: fls. few (10–12), on long pedicels in an open umbel. S. Eu. B.M. 978.

12. **senèscens,** Linn. Scape 1–2 ft.: lvs. narrow, erect, often twisted: fls. rather small, numerous, in a rather dense head. Eu. B.M. 1150.

13. **Éllisii,** Hook. f. Lvs. 4–5, 1 ft., 2½ in. wide, glaucous green: scape 1 ft., very stout, being ⅜in. diam.; fls. rose with white toward the base, wide-spreading, 1½ in. or more long and stiff and erect in fr. Persia. B.M. 7875.

14. **albopilòsum,** C. H. Wright. Very robust: lvs. strap-shaped, 1¾ in. wide, 18 in. or less long: scape 1 ft. as many as 80-fld.; fls. deep lilac with metallic sheen, the segms. nearly 1 in. long, rigid after flowering. Persia, etc. B.M. 7982. G.C. III. 34:40.—Probably the largest-fld., and most imposing garden species.

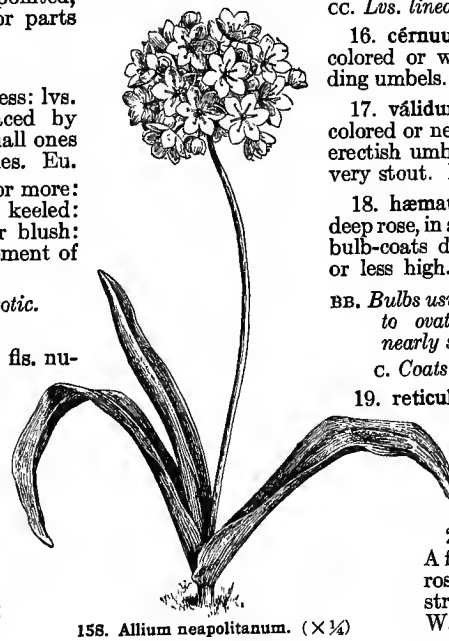
AAA. *Group III. Native alliums, sometimes advertised.*

The species in Group II, comprise those that are likely to be in general cultivation. Aside from these there are various native species, mostly from western America, which are offered by dealers in American plants. These are recorded below.

B. *Bulbs clustered, narrowly oblong: scape terete.*

C. *Lvs. elliptic-lanceolate, 2 or 3.*

15. **tricòccum,** Ait. COMMON WILD LEEK. Fig. 159. Fls. greenish white on scape 4–12 in. high in early spring. Grows in clumps. New Eng. to Wis. and N. C.



158. Allium neapolitanum. (×¼)

CC. *Lvs. linear, flat or channelled.*

16. **cérnuum,** Roth. Fls. rose-colored or white, in open, nodding umbels. Alleghanies and W.

17. **válidum,** Wats. Fls. rose-colored or nearly white, in dense erectish umbels: scape 1–2½ ft., very stout. Nev., Calif., Ore.

18. **hæmatochìton,** Wats. Fls. deep rose, in a small, erect umbel: bulb-coats deep red: scape 1 ft. or less high. Calif.

BB. *Bulbs usually solitary, globose to ovate: scape terete or nearly so.*

C. *Coats of bulbs fibrous.*

19. **reticulàtum,** Fraser. Scape 3–8 in.; fls. white to rose, with thin segms. W. Amer. B.M. 1840, as *A. stellatum.*

20. **Geyèri,** Wats. A foot high, stouter: fls. rose, with broad acute strongly nerved segms. W. Amer.

CC. *Coats of bulb not fibrous.*

D. *Lvs. 2 or several.*

E. *Ovary with only 3 crests, or none at all.*

21. **scapòsum,** Benth. Fls. white, red-veined, in a loose, few-fld. umbel: bulbs dark: scape 1 ft. or more. W. Amer.

159. Allium tricoccum. (×⅓)

22. **mâdidum,** Wats. Fls. white or nearly so, in a many-fld. umbel: bulbs white: scape less than 1 ft., angled. Ore.

23. **Cùsickii,** Wats. Fls. rather numerous, nearly white: lvs. ¼in. wide: scape 3–4 in. Ore.

24. **Bolánderi,** Wats. Fls. rose, few, the segms. serrulate: scape 4–10 in. Calif.

25. **unifòlium,** Kellogg. Lvs. several, narrow and flat: scape stout, 1–2 ft.; fls. rose, 10–30, the segms. ovate-lanceolate, exceeding stamens and style. Calif.

EE. *Ovary distinctly 6-crested: fls. usually rose-colored.*

F. *Scape usually more than 6 in. high (in the wild).*

26. **stellàtum,** Fraser. Bulb-coats reddish: scape 6–18 in.; pedicels ½–¾in. long; stamens and styles exserted. W. Amer. B.M. 1576.

27. **Sânbornii,** Wood. Bulb-scales white: scape 12–24 in.; pedicels shorter; umbel densely many-fld.; stamens and styles exserted. Calif.

28. **attenuifòlium,** Kellogg. Lvs. channelled: scape slender, 6–15 in., leafy below; umbel dense; fls. nearly white. W. Amer.

FF. *Scape usually less than 6 in. high (in the wild).*

29. **serràtum,** Wats. Lvs. very narrow: filaments broadened at the base. W. Amer.

30. **Bídwelliæ.** Wats. Scape 2–3 in.: umbel few-fld., the pedicels ½in. long; filaments filiform. Calif.

DD. *Lf. solitary, linear or filiform: scape 2–5 in. high: caps. 6-crested.*

31. **fimbriàtum,** Wats. Lf. filiform and revolute: scape 3 in.; fls. deep rose, stigma 3-cleft. S. Calif.

BBB. *Bulbs mostly solitary: scape stout, 2-winged: lvs. 2, broad.*

C. *Stamens not exserted.*

32. **falcifòlium,** Hook. & Arn. Fls. rose, the segms. minutely glandular-serrate and twice longer than stamens: scape 2–3 in. W. Amer.

33. **ánceps,** Kellogg. Fls. white, with purplish veins, the segms. little longer than stamens. Calif., Ore.

CC. *Stamens exserted.*

34. **platycaùle,** Wats. Fls. rose, the segms. long-acuminate: scape 3–5 in. Calif. B.M. 6227 (as *A. anceps*)

L. H. B.

ALLOPLÉCTUS (*diversely plaited;* referring to appearance of the calyx). *Gesneràceæ.* Tender tropical evergreen shrubby plants, with tubular yellowish axillary fls. and opposite lvs.; one of each lf. in the pair smaller than the other, their under surfaces usually reddish or purplish. To be grown in the warm-house with similar treatment as that for Gesnera.

rèpens, Hook. Trailing by means of roots thrown out between the pairs of lvs.: lvs. ovate, coarsely serrate, hairy or smooth: calyx pale green, blotched with purple; corolla yellow, tinged red, gaping; tube swollen at the base; limb of 4 spreading segms., the uppermost being twice cut. E. Indies. B.M. 4250.

sparsiflòrus, Mart. Erect: lvs. ovate-oblong, acute entire; petiole and nerves beneath often red: calyx of 5 cordate or triangular dark blood or purple sepals, forming a striking contrast to the yellow club-shaped densely hairy corolla; limb of corolla of 5 equal segms. Brazil. B.M. 4216, erroneously as *A. dichrous.*

Schlímii, Planch. & Lind. Fig. 160. Lvs. acuminate, rounded or subcordate at base, oblong, green above, violet or purple-violet beneath: fls. axillary, in pairs or sometimes more numerous, the calyx spotted with green; corolla yellow-scarlet below, shading upward into a delicate violet above. Trop. S. Amer. F.S. 8:827.

A. Forgétii, Hort. Corolla pale yellow, spurred on the back. Peru.

N. TAYLOR.†

ALLSPICE. The dry berry of the Pimento (*Piménta officinàlis,* Lindl.), an evergreen tree of the *Myrtàceæ.* The tree grows in the West Indies. Jamaica yields much of the product. The fresh berry is about the size of a pea. It is borne in clusters. The word allspice is also applied to various plants with aromatic fragrance, as Calycanthus. See *Pimenta.*

ALMOND. A name given to the tree and fruit of *Prùnus commùnis,* Fritsch. (*Amýgdalus commùnis,* Linn.), of the *Rosàceæ.* It is also applied to certain dwarf ornamental trees or bushes, as flowering almond (see *Prunus*).

The almond has been cultivated from time immemorial. It is thought to be native to the Mediterranean basin. Some inquirers have supposed it to be the original of the peach, but this idea is evidently untenable. The flowers are peach-like and handsome (Fig. 161). The almond nut of commerce is the pit or stone of a peach-like fruit (Fig. 162). The fleshy part, which is so thick and edible in the peach, is thin and hard, and it splits at maturity. There are two general tribes or races of almonds,—the bitter and the sweet. The former has a bitter kernel, which is used in the manufacture of flavoring extracts and prussic acid. It is grown mostly in Mediterranean countries. Of the

160. Alloplectus Schlimii. (×½)

sweet or edible almonds, there are two classes,—the hard-shell and the soft-shell. The former is of little value, and is not grown to any extent. The soft-shell type produces the edible almonds of commerce. Some of the thinnest-shelled forms are known as Paper-shells.

161. Flower of common almond.

It was once thought that almond-growing could be successfully practised in the peach-growing sections of the East, but late spring frosts, and other difficulties, have caused the effort to be abandoned commercially. Individual almond trees are occasionally seen, and they frequently bear profusely. They are nearly as hardy as the peach. The commercial cultvation of the almond on this continent is confined to western America, and the remainder of this account is therefore written from the Californian standpoint.

L. H. B.

Almond-growing in California has received the attention of horticulturists for half a century, and during the whole of its course the industry has been marked by vicissitudes which, it must be admitted, are not yet ended. Two chief sources of difficulty are now clearly discerned to have attended the effort from its beginning, and present knowledge may enable planters to avoid, in the future, errors that have led to much disappointment and loss—the vestiges of which still encumber the ground, though clearing is proceeding rapidly. Thus far the almond tree has yielded more firewood than any other single fruit tree which has been largely planted in California, and yet planting has continued, planting and uprooting keeping pace, so that about 1,500,000 trees are annually reported by the county assessors, of which number about two-thirds may be counted of bearing age. The California almond product for a series of years is estimated as follows:

1905	2,125 tons	1909	1,650 tons
1906	900 "	1910	2,750 "
1907	750 "	1911	1,700 "
1908	3,000 "	1912	3,000 "

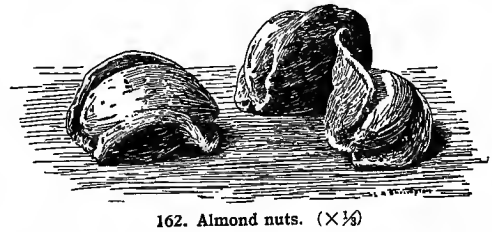
Irregularity in production is mainly due to the occurrence or absence of spring frosts. In spite of these facts, the almond will remain an important California product, through the satisfactory performance of trees enjoying favorable environment, which is being generally accepted as a safe guide for current planting.

The two chief sources of failure with the almond are the sterility of many varieties without cross-pollination, and the extreme propensity of the tree for early blooming, with the consequent destruction of the bloom or the young fruit by temperature very little below the freezing point. These two evils have been singularly associated historically, and only lately have they been shown to be independent factors and both of them demanding the closest attention from planters. At first it was thought that the wide planting of self-sterile varieties by themselves was the cause of disappointment, because, after years of chopping-out or grafting-over old unproductive trees to the Prune d'Agen, for which it is an excellent stock, it was observed, by chance, that the Languedoc variety adjacent to Drake's seedling, of local origin, was heavily laden with nuts when it was sterile without such association. Attention was then directed to the growth of seedlings, and a large lot of seedlings of the bitter almond, grown by A. T. Hatch, exhibited such satisfactory bearing habit and such striking variation toward new types of the soft-shell sweet almond that the growth of new selected California seedlings was seized upon as a panacea for the previously experienced troubles with the almond. These new varieties were conceived to be not only self-fertile but hardy, and large plantations were made without due regard to the frosty character of the locations. Low valley lands of great area, and some extent of high plateaux, were planted. Fine, large trees grew only to lose their crops year after year by frosts from February to April, until the growers cast the trees upon the wood-pile. As a deduction of the experience of several decades, we have arrived at what seems now to be the proper conception of the situation of the almond in California, which is, that the most prolific varieties must be chosen, must be associated for purposes of cross-pollination, and must be planted in places of least liability to frost. There is a factor of some moment in the late-blooming habit of some varieties, which will be considered presently.

The soil best suited to the almond is a light, well-drained loam. The tree makes a strong and rapid root-growth, and is more tolerant of drought than any other of our leading deciduous fruit trees. For this reason, as well as to avoid frost, it is often desirable to place the almond on the higher and drier lands of the valley—providing the soil is not heavy and too retentive of surplus water in the rainy season. The root is most intolerant of standing water, and will quickly die if exposed to it. Because of its thrift in light, dry soils, the almond root is used rather largely as a stock for the Prune d'Agen, and to some extent for the peach in the dry valleys.

Almond trees are grown by budding into seedlings grown from either the sweet or the bitter hard-shell almonds, the bud being set during the first summer's growth of the seedling, and then either planted out as a dormant bud the following winter or allowed to make one season's growth on the bud in the nursery. The tree grows so rapidly, both in root and top, that only yearling trees are used.

At transplanting, the young trees are cut back so as to form a low head with only about a foot of clear trunk. They are allowed to make free growth during the following summer, and in the following winter are cut back so as to encourage branching on the main limbs within a foot of their attachment to the trunk. At the same time, the branches are reduced to four or five in number, symmetrically arranged around the stem and at good distance from each other, so that they shall not unduly crowd each other as they enlarge. Another full growth during the following summer and another cutting back the following winter give the trees the vase-form on the outside, with enough interior branches to fill the



162. Almond nuts. (×⅓)

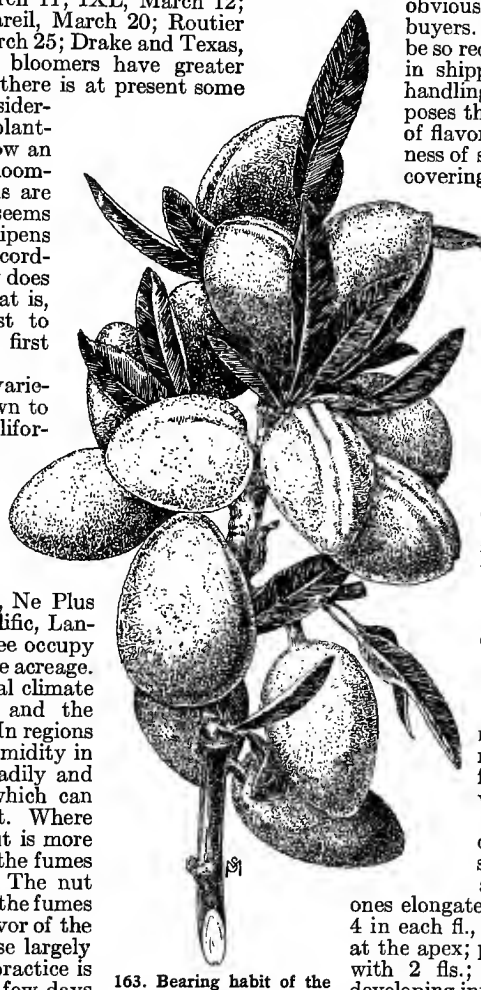
inside of the tree without crowding. Thus the tree is systematically pruned after each of its first two years' growth in the orchard. After that, shortening-in of the branches usually ceases, and the third summer's growth is allowed to stand for fruit-bearing, with only thinning-out of growth to prevent crowding. This thinning-out has to be done from time to time in later years, otherwise the tree becomes too thick, and interior branches dwindle for lack of light. The amount of thinning varies in the different climates of the state: the greater the heat, the denser the tree for its own protection. With the proper adjustment of heat and light, fresh bearing wood may be encouraged in the lower part of

the tree, otherwise it becomes umbrella-shaped, with the fruit wood at the top and bare poles below.

The almond is the earliest bloomer of our common fruits. It puts forth flowers sometimes as early as January, but the usual date is about February 10 for the earliest bloomers in the warmer parts of the state, with the later bloomers at intervals thereafter until April 1. Records of full bloom of a number of varieties widely grown in California, which have been kept at the University of California substation, situated in the Sierra foot-hill region, show the following succession: Commercial, February 27; Sultana and Paper-shell, March 10; King and Marie Duprey, March 11; IXL, March 12; Languedoc, March 19; Nonpareil, March 20; Routier Twin, March 24; Pistache, March 25; Drake and Texas, April 2. Obviously the late bloomers have greater chance of escaping frost, and there is at present some disposition to make this a consideration in selecting varieties for planting. The dates just given show an extreme variation in time of blooming. Some years the intervals are much shorter, but the relation seems to be constant. The crop ripens from August 15 to October 1, according to locality. Early maturity does not follow early blooming—that is, as with other fruits, the first to bloom are not necessarily the first to ripen.

Not less than twenty-five varieties of almonds have been grown to a greater or less extent in California. Varieties of foreign origin have almost wholly given place to selected seedlings of local origin, and of these a very few constitute the main crop at present. These are named in the order of their acreage, as follows: Nonpareil, Ne Plus Ultra, IXL, Drake, Texas Prolific, Languedoc. Of these, the first three occupy not less than three-fourths of the acreage.

In handling the crop, the local climate modifies methods somewhat, and the growth-habit is also involved. In regions very free from atmospheric humidity in the summer, the hull opens readily and discloses a clean, bright nut, which can be marketed without treatment. Where this is not the case, and the nut is more or less discolored, bleaching in the fumes of sulfur has to be practised. The nut must be dry before sulfuring, or the fumes will penetrate and injure the flavor of the kernel. Sulfured nuts also lose largely in power of germination. The practice is to gather the nuts, dry for a few days in the sun, then spray with water very lightly or with a jet of steam, so that only the surface of the shell is moistened, and then sulfur, and a light color can be secured without penetration of the fumes. The nuts can usually be gathered from the ground as they naturally fall, or can be brought down by shaking or the use of light poles. Some varieties are more easily harvested than others, and the same variety falls more readily in some localities than in others. A greater or less percentage, according also to variety and locality, will have adhering hulls, and for clearing them, locally-invented machines, called almond-hullers, are used. Early rains in some localities are apt to stain the nuts. Such stains cannot be removed by sulfuring, and the nuts have to be crushed and the product marketed as kernels for the use of confectioners. Machinery is also used for this operation, and a considerable fraction of the product reaches the market in this form because of the demand for candied and salted almonds.



163. Bearing habit of the almond.

The standard of excellence in the almond, from a commercial point of view, as learned by the experience of California producers, is that the kernel must be as smooth, symmetrical and plump as possible. The twinning of kernels, welcome as it may be to searchers for philopenas, results in misshapen kernels, which are very objectionable to the confectioners, who are very large users of almonds. Constancy to single kernels is therefore a good point in a variety.

Large proportion of kernel to shell by weight is also, obviously, an important point to almond-buyers. At the same time, the shell may be so reduced in strength as to break badly in shipping in sacks and in subsequent handling. Incomplete covering also exposes the kernel to the sulfur and to loss of flavor. The ideal is such degree of thinness of shell as can be had with complete covering of the kernel and durability in handling.

Careful comparison of the proportion of kernel weight to gross weight of the popular California varieties, as compared with a leading imported variety, was made by a committee of the California Horticultural Society, with the following result: From one pound of each of the following varieties the net weight of kernels in ounces was: Imported Tarragona, $6\frac{2}{5}$; California Languedoc, $7\frac{1}{2}$; El Supremo, $7\frac{1}{2}$; Drake, $8\frac{3}{4}$; IXL, 9; Commercial, $9\frac{1}{4}$; La Prima, $9\frac{1}{2}$; Princess, $9\frac{1}{2}$; Ne Plus Ultra, 10; King, 10; Paper-shell, 11; Nonpareil, 11 to 13.

EDWARD J. WICKSON.

ALMOND, DEMERARA: *Terminalia Catappa.*

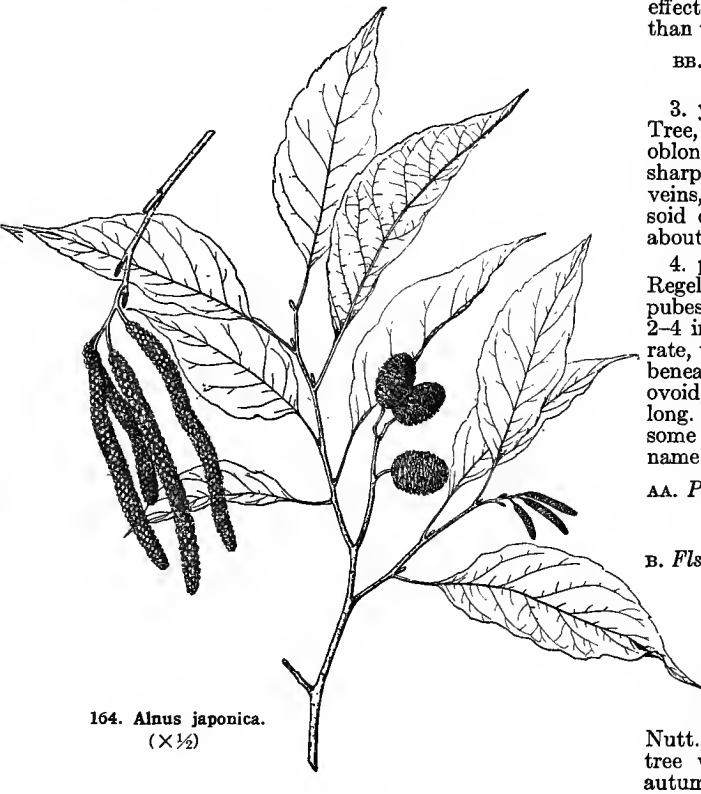
ALMOND, FLOWERING: *Prunus.*

ÂLNUS (the ancient Latin name). *Betulàceæ.* ALDER. Ornamental woody plants grown chiefly for their foliage; some species are valuable as timber trees.

Trees or shrubs: lvs. alternate, deciduous, short-petioled, usually serrate or dentate: fls. monœcious, apetalous, in catkins; staminate ones elongated, each bract with 3 fls.; stamens 4 in each fl., with short filaments not divided at the apex; pistillate catkins short, each bract with 2 fls.; styles 2; the pistillate catkins developing into a ligneous, generally ovoid cone with persistent, 5-lobed scales: fr. a small nutlet.—About 30 species in the northern hemisphere, in Amer. south to Peru. Monograph by Winkler in Engler's Pflanzenreich: Betulaceæ 101 (1904).

The alders are deciduous trees or shrubs with medium-sized leaves and pendulous staminate catkins in spring before the leaves; the short pistillate catkins developing into woody cones about ½ to 1 inch long and usually arranged in small racemes. The profuse male catkins are pleasing in early spring. The wood is valuable for its durability in water; of the native species, *A. rubra* is the most important timber-tree; in the Old World, *A. glutinosa* and *A. japonica*. Most species are suitable for planting on damp soil, where they grow rapidly, but *A. cordata* prefers a drier situation; also *A. japonica*, *A. incana* and *A. tinctoria* grow well in drier situations.

Usually propagation is by seeds gathered in the fall and well dried; sown in spring with but slight covering, and kept moist and shady, they germinate soon; a slight covering with moss, taken off when the seedlings appear, will be useful. At the end of the same year or the following spring, the seedlings are transplanted, usually into rows 1 to 2 feet apart and 6 inches from each other. After two years, they may be planted where they are to stand. The shrubby species, also *A. glutinosa*, grow from hardwood cuttings placed in moist and sandy soil, also from layers, and *A. incana* from suckers. Rarer kinds are grafted on common potted stock in early spring in the propagating-house; grafting out-of-doors is rarely successful.



164. Alnus japonica. (×½)

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A. *Pistillate catkins terminal, inclosed during the winter in the bud, opening in spring: fr. with broad membranous wing: winter-buds sessile with 2 or more unequal scales.* (*Alnobetula.*)

B. *Lvs. ovate or elliptic, with 5–10 pairs of veins.*

1. **víridis,** DC. (*A. Alnobétula,* Hartig. *A. undulàta,* Willd.). European Green Alder. Shrub, 2–6 ft.: lvs. elliptic or ovate, to round-ovate, acute, usually narrowed at the base, sharply serrulate, 1–2½ in. long, glutinous while young, bright green above, pale green and glabrous beneath or pubescent on the veins: staminate catkins 2–3½ in. long; pistillate catkins with glabrous or puberulous peduncles: cones 3–4, oblong, slender-peduncled. March, April. Mts. of Eu. L.B.C. 12:1141. H.W. 2:14.

2. **Mitchelliàna,** Curt. (*A. víridis* of most American authors). American Green Alder. Shrub, 2–10 ft.: young branchlets glabrous or sparingly pubescent: lvs. elliptic or ovate-elliptic, acute or obtuse, rounded or subcordate at the base, 1½–3 in. long, densely serrulate, glutinous while young, with impressed veins above, reticulate beneath and glabrous: staminate catkins 2–3 in. long; pistillate catkins with pubescent peduncles: cones 3–6, oblong, slender-peduncled. March, Apr. Mts. of N. E. Amer., west to Brit. Col., south to N. C. —Hardy shrub with handsome bright green foliage, very aromatic when unfolding and of very pleasant effect in spring with its long male catkins; handsomer than the preceding species.

BB. *Lvs. ovate-oblong to ovate-lanceolate, with 12–24 pairs of veins.*

3. **yásha,** Matsum. (*A. firma* var. *yásha,* Winkl.). Tree, to 30 ft.: young branchlets pubescent: lvs. ovate-oblong, 2–4 in. long, acute, usually rounded at the base, sharply and irregularly serrate, with 12–18 pairs of veins, pubescent on the veins beneath: cones 1–3, ellipsoid or sub-globose, ¾in. long, on slender peduncles about 1 in. long. Japan. J.C.T. 16:2.

4. **péndula,** Matsum. (*A. firma* var. *multinérvis,* Regel). Tree, to 30 ft., or shrub: young branchlets pubescent: lvs. oblong-lanceolate, acute or acuminate, 2–4 in. long, irregularly and often nearly doubly serrate, with 18–24 pairs of veins, pubescent on the veins beneath, at maturity nearly glabrous: cones 3–5, ovoid, about ½in. long, in pendulous racemes, 1–2 in. long. Japan. S.I.F. 2:12. J.C.T. 16:3.—Very handsome alder, still rare in cult.; the plant cult. under this name is usually the preceding species.

AA. *Pistillate catkins axillary, appearing in autumn: winter-buds with 2 equal scales, stalked.* (*Gymnothyrsus.*)

B. *Fls. opening in the fall from catkins of the same year: lvs. not plicately folded in the bud.*

5. **marítima,** Nutt. (*A. oblongàta,* Regel, not Ait. nor Willd.). Tree, to 30 ft.: lvs. cuneate, oblong or obovate, shining above, pale green beneath, glabrous, remotely and crenately serrate, 2–4 in. long: cones 2–4, large, on short, stout peduncles. Del., Md. S.S. 9:458. G.F. 4:269. Nutt., N. Amer. S. 1:10.—Ornamental shrub or small tree with handsome shining foliage, attractive in autumn with its male catkins.

BB. *Fls. opening in early spring before the lvs., from catkins formed the previous year and remaining naked during the winter.*

C. *Lvs. not plicate in the bud, green beneath, veins arching: cones 1–6, long-stalked.*

6. **japónica,** Sieb. & Zucc. (*A. firma,* Hort., not Sieb. & Zucc.). Fig. 164. Tree, 50–80 ft.: lvs. cuneate, oblong-lanceolate, acuminate, sharply and irregularly serrulate, glabrous at length, bearded in the axils of the veins beneath, 2–6 in. long: cones 3–6, peduncled. Japan. G.F. 6:345 (adapted in Fig. 164). S.I.F. 1:19.—Tall, pyramidal tree with dark green foliage; the largest and perhaps the most beautiful of all alders.

7. **cordàta,** Desf. (*A. cordifòlia,* Ten. *A. tiliàcea,* Hort.). Small tree, 20–50 ft.: lvs. cordate, ovate or roundish, acuminate, 2–4 in. long, bearded in the axils beneath, glandular when young: cones 1–3, ovoid, about 1 in. long, peduncled; nutlets with narrow wing. Italy, Caucasus. L.B.C. 13:1231. G.C. II. 19:285.—Round-headed tree with handsome, distinct foliage, changing orange-yellow in autumn, resembling that of a linden or pear, therefore sometimes called *A. tiliæfòlia* or *A. pyrifòlia,* in gardens. Not quite hardy N.

CC. *Lvs. plicate in the bud, the veins going straight to the points of the larger teeth: cones 4–10, short-stalked or sessile.*

D. *Under side of lvs. glaucous, not bearded: cones sessile or short-stalked.*

8. **incàna,** Willd. Shrub or tree, to 60 ft.: branches pubescent: lvs. oval or oblong-ovate, acute, 1¼–4 in. long, doubly serrate, pubescent or nearly glabrous beneath: cones 4–8, mostly sessile, ½in. long. Northern hemisphere, in different varieties. H.W. 2:13.

Var. **glaùca,** Ait. (*A. glaùca,* Michx.). Shrub, to 12 ft.: lvs. often nearly glabrous beneath. N. Amer., Eu. Em. 251.

Var. **vulgàris,** Spach. Tree, to 50 ft.: lvs. usually densely pubescent beneath: cones 1 in. long. Eu., Asia.

Var. **pinnatífida,** Spach (var. *laciniàta,* Hort.). Lvs. pinnately lobed or cleft, with dentate lobes.

9. **tinctòria,** Sarg. (*A. incàna* var. *tinctòria,* Hort.). Fig.165. Tree, to 60 ft.: young branchlets glabrous or slightly pubescent: lvs. broadly ovate, 4–6 in. long, membranaceous, coarsely doubly serrate, slightly lobed, glaucous and rufously pubescent on the veins beneath. Japan. G.F. 10:473 (adapted in Fig. 165). S.I.F. 1:19 (as var. *glauca*).—Handsome ornamental tree of very vigorous growth, with large foliage.

10. **rùbra,** Bong. (*A. oregàna,* Nutt.). Tree, 40–50 ft.: lvs. oblong-ovate, 3–5 in. long, crenate-serrate, slightly lobed, revolute on the margin, nearly glabrous beneath; petioles and veins orange-colored: cones 6–8, oblong. W. N. Amer. S.S. 9:454. Nutt., N. Amer. S. 1:9.

DD. *Under side of lvs. green or brownish green, usually bearded.*

E. *Cones upper sessile.*

11. **rugòsa,** Spreng. SMOOTH ALDER. Shrub, to 25 ft.: young branchlets pubescent or nearly glabrous: lvs. ovate or broadly elliptic to obovate, acute or obtuse, 2–5 in. long, doubly serrate and often slightly lobed, beneath covered more or less with brownish pubescence or glabrous: cones 4–10, the upper sessile, the lower short-stalked, ovoid, about ½in. long. E. N. Amer. Mx. 3:4. Var. **serrulàta,** Winkl. (*A. serrulàta,* Willd.). Branchlets glabrous or nearly so: lvs. usually obovate, obtuse, finely and doubly serrulate, glabrous or nearly glabrous beneath. Em. 248.—By most European botanists this variety is considered a distinct species, but, though the extreme forms seem quite distinct, they are connected by all kinds of intermediate forms. In flower, *A. rugosa* is easily distinguished from *A. incana* by the pistillate catkins which are upright in *A. rugosa,* nodding in *A. incana.*

165. Alnus tinctoria. (×⅓)

166. Alnus glutinosa. (×½)

EE. *Cones all distinctly peduncled.*

12. **glutinòsa,** Gaertn. (*A. vulgàris,* Hill. *A. rotundifòlia,* Mill. *A. commùnis,* Desf.). BLACK ALDER. Fig. 166. Tree, to 70 ft.: lvs. orbicular or obovate, rounded or emarginate at the apex, 2–5 in. long, irregularly obtusely serrate, with 5–7 pairs of veins, nearly glabrous beneath, glutinous when unfolding: cones distinctly peduncled. Eu., N. Afr., Asia, naturalized in some localities in N. Amer. H.W. 2:12. H.T. 130.—A vigorously growing tree with dark green, dull foliage, valuable for planting in damp situations. Commonly planted in many forms: Var. **aùrea,** Versch. Lvs. yellow. I.H. 13:490. Var. **denticulàta,** Ledeb. (*A. oblongàta,* Willd.). Lvs. usually cuneate, serrulate. S. Eu. Var. **barbàta,** Callier (*A. barbàta,* C. A. Mey.). Lvs. ovate, acute, pubescent on the veins beneath. Caucasus. Var. **imperiàlis,** Desf. Lvs. deeply pinnately lobed with lanceolate or nearly linear lobes. Var. **incìsa,** Willd. (var. *oxyacanthifòlia,* Spach). Lvs. small, deeply incised, like those of *Cratægus oxyacantha.* Var. **laciniàta,** Willd. Lvs. pinnately lobed; lobes oblong. Var. **rubrinérvia,** Dipp. Lvs. large and shining, with red nerves and petioles: pyramidal tree of vigorous growth, very handsome.

A. acuminàta, HBK. Tree: lvs. usually ovate and pubescent beneath, doubly serrate. Cent. Amer., north to Ariz.—*A. cremastógyne,* Burkill. Tree: young branchlets glabrous; lvs. oblong-obovate, glabrous, sharply serrate, 3–4 in. long: cones cylindric, solitary on slender peduncles, about 1½ in. long. W. China.—Recently intro., probably not hardy N.—*A. firma,* Sieb. & Zucc. (A. Sieboldiana, Mats.). Allied to A. yasha. Tree: lvs. ovate, or ovate-oblong, acute, rounded at the base, with 10–15 pairs of veins, 3–5 in. long: cones about 1 in. long, solitary on a peduncle ½–1 in. long. Japan. S.I.F. 2:12.—*A. fruticòsa,* Rupr. (A. viridis var. sibirica, Regel). Allied to A. viridis. Shrub: lvs. broadly ovate or elliptic-ovate, usually rounded at the base, nearly doubly or sinuately serrate. Siberia, Corea.—*A. hirsùta,* Turcz. (A. incana var. hirsuta, Spach). Allied to A. tinctoria. Tree; young branchlets, and petioles tomentose: lvs. suborbicular to elliptic, acutish, denticulate and slightly lobed, ferrugineously tomentose beneath. Japan, Manchuria.—*A. jorullénsis,* HBK. Allied to A. acuminata. Lvs. oblong-lanceolate, coarsely dentate. Cent. Amer.—*A. móllis,* Fernald. Closely allied to A. crispa. Shrub or small tree: branchlets pubescent: lvs. pubescent beneath, 2–4 in. long. N.E. Amer., west to Lake Winnipeg, south to Mass.—*A. nítida,* Endl. Tree, to 100 ft.: lvs. ovate to ovate-oblong, short-acuminate, not plicate, 3–4 in. long, entire or remotely serrulate, bright green and lustrous

above, glabrous: male catkins very slender, to 6 in. long: cones 2–4, peduncled. Himalayas. B.M. 7654.—*A. oblongifòlia*, Torr. Tree, 20–30 ft.: lvs. oblong-ovate, cuneate, doubly serrate, 2–3 in. long: atrobiles ½–1 in. long, peduncled. N. Mex. and Ariz. S.S. 9:457.—*A. occidentàlis*, Dipp.=A. tenuifolia.—*A. orientàlis*, Decne. (A. barbata, Hort., not C. A. Mey. A. firma, Hort., not Sieb. & Zucc. A. macrophylla, Hort.). Allied to A. cordata. Tree: lvs. ovate-oblong, obtusely or crenately serrate, 2–5 in. long, glabrous, with 8–10 pairs of veins: cones ovoid, glutinous, ½–1 in. long; nutlets without wing. Asia Minor.—*A. pubéscens*, Tsch. (A. glutinosa×incana). Lvs. roundish-ovate or obovate, irregularly serrate, pubescent beneath. Natural hybrid.—*A. rhombifòlia*, Nutt. Tree, 60–80 ft.: lvs. cuneate, oval or ovate, 2–3½ in. long, finely serrate, yellowish green and puberulous beneath: strobiles oblong, peduncled. W.N. Amer. S.S. 9:456.—*A. Sieboldiàna*, Mats.=A. firma.—*A. sinuàta*, Rydb. (A. sitchensis, Sarg.). Allied to A. viridis. Shrub, 3–16 ft.: lvs. slightly lobed, serrulate, glabrous, thin. W. N. Amer. S.S. 14:727.—*A. Spæthii*, Callier (A. japonica×subcordata). Tree: lvs. ovate-lanceolate, sharply serrate, violet-purple when unfolding. Of garden origin. *A. subcordàta*, C. A. Mey. Tree, 30–50 ft.: lvs. ovate or oblong-ovate, rounded at the base, 2–6 in. long, crenately or doubly serrate, glabrous or sometimes pubescent beneath: cones about 1 in. long: nutlets with a narrow wing. Caucasus.—*A. tenuifòlia*, Nutt. (A. incana var. virescens, Wats. A. occidentalis, Dipp.). Small tree, occasionally 30 ft.: lvs. ovate, 2–4 in. long, slightly lobed and doubly serrate, green and nearly glabrous beneath. W. N. Amer. S. S. 9:455.

ALFRED REHDER.

ALOCÀSIA (name made from *Colocasia*). *Aràceæ*. Warmhouse foliage plants, with green, veined and mottled, large hanging leaves.

Stem thick, short or assurgent, densely marked with lf.-scars: lvs. with long sheathed petioles, the blade, when young peltate, when old usually sagittate-cordate, the basal lobes commonly more or less united: spathe with the tube much shorter than the blade, ovoid or oblong, convolute, the blade oblong, usually boat-shaped; spadix shorter than spathe.—Stove foliage plants from E. Asia, comprising about 40 species, in addition to many hybrids. Related to Caladium and Colocasia, from which separated by technical fr. characters. See Monogr. by Engler in De Candolle's Monographiæ Phanerogamarum, Vol. II.

167. Alocasia Sanderiana.

The species of alocasia grown in greenhouses have foliage of great beauty and coloring and rank high amongst ornamental foliage plants. The leaves are remarkable for their coloring, markings, size and shape, some of them being of a rich metallic coloring while others are green and green-and-white with prominent veining. Alocasias are propagated by suckers or cuttings of the rhizomes, placed in small pots containing a mixture of light fibrous peat and sand in equal proportions, and plunged in a close frame or propagating-box with bottom heat. They may also be grown from seeds sown in 4-inch pots, in a light peaty soil in a temperature of 75° F. The month of March is the best time for propagating and potting. The evergreen species (as *A. cuprea, A. longiloba, A. Lowii, A. Regina*) thrive best in a compost of two parts fibrous peat and sphagnum moss and one part lumps of fibrous loam, to which should be added a sprinkling of silver sand and a few nodules of charcoal to keep the whole sweet. The herbaceous species (as *A. macrorhiza*) do best in good fibrous loam to which one-third of well-rotted cow-manure or pulverized sheep-manure has been added. Perfect drainage of the pots is absolutely necessary, and, in potting, the evergreen species should be coned up 2 or 3 inches above the rim of the pot, and finished off with a surfacing of live sphagnum moss. The season of active growth begins about the first of March, when plants should be given a temperature of 70° at night, with a rise of 15° by day, and the atmosphere must be kept in a humid condition. They should be given a position free from drafts and direct sunlight. They require an abundance of water at the roots as the leaves develop, and are greatly benefited by an occasional watering of clear liquid sheep- or cow-manure. To secure the best development of the leaves, heavy syringing should be avoided, but frequent spraying on all fine days with an atomizer sprayer is very beneficial. Towards winter the humidity of the atmosphere and the supply of water to the roots should be reduced with the evergreen species, and gradually withheld altogether as the leaves mature, with the herbaceous species. The temperature during winter should not fall below 60°. (E. J. Canning.)

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A. *Lvs. distinctly notched or undulate on the margin.*

1. **princeps,** Nichols. Lvs. sagittate, the basal lobes narrow and spreading, the margins deep-sinuate; upper surface olive-green, with darker veins, the under lighter colored, with brown veins and margin; petioles brown-spotted, slender. E. Indies.

2. **Sanderiàna,** Bull. Fig. 167. Lvs. long-sagittate, with deeply notched margin, the basal lobes wide-spreading, deep glossy green with metallic reflection, with prominent white margins and veins; petioles brownish and striped. Philippines. Gng. 6:84. G.Z. 28, p. 267. J.H. III. 45:173.—One of the best of recent introductions. Runs into various forms, and has entered largely into cult. hybrids.

AA. *Lvs. plain and entire on the margin.*

B. *Markings chiefly on the petioles, the blades green.*

3. **zebrìna,** Koch & Veitch. Lvs. triangular-sagittate, the margin somewhat repand, the front lobe oblong-triangular, cuspidate, the basal lobes obtuse; petioles beautifully marked with large zigzag bands of green. Philippines. F.S. 15:1541–2.

4. **Villeneúvei,** Lind. & Rod. Lvs. sagittate-ovate, the veins of lighter green and prominent, basal lobes very unequal; petioles spotted with chocolate-brown. Large. Borneo. I.H. 34:21.—Named for de Villeneuve, Brazilian ambassador to Belgium.

BB. *Markings or coloration chiefly on the lf.-blades.*

C. *Veins and midrib light yellow.*

5. **Líndenii,** Rod. Lvs. cordate-ovate, long-pointed, 8–12 in. long, bright green, with yellowish veins curving off from the midrib and vanishing near the margin; petioles nearly white. New Guinea. I.H. 33:603.—Bruised lvs. emit a strong odor.

CC. *Veins and midrib white or silvery.*

D. *Midrib and primary nerves not bordered.*

6. **longíloba,** Miq. (*A. gigantèa*, Hort.). Petioles 2 ft., greenish white, mottled purple; blade sagittate, 18 in. long, the basal lobes very long and erect, the upper surface green, with silvery or gray bands along veins and midrib, the under surface light purple. Java.

7. **Lòwii,** Hook. Petioles 2–3 ft., rose-color; blade narrow-ovate, 18 in. long and a third as wide, long-pointed, the basal lobes long-acute, upper surface olive-green, with very distinct silvery bands, under surface rich purple. Borneo. H.F. III. 9: pl. 6. F.S. 21:2204. B.M. 5376. A.F. 11:559 (as var. *grandis*).

DD. *Midrib and primary nerves bordered with pale or gray-green.*

8. **Putzèysii,** N. E. Br. Much like *A. longiloba:* lvs. broader (oval-sagittate), dark metallic green, prominently veined and bordered white, the petioles pale red-purple, under surface dark purple. Sumatra. I.H. 29:439. G.C. II. 19:501.—More brilliant than *A. longiloba,* and has wider spaces between the veins.

9. **Thibautiàna,** Mast. Petioles 3 ft., greenish; blade 2 ft. long and 18–20 in. broad, ovate-cordate, the basal lobes broad and rounded, olive-green, with broad silvery

168. Alocasia cuprea. (×⅛)

veins and rib, the under surface deep purple. Borneo. G.C. III. 17:485. I.H. 28:419. G.Z. 25, p. 265.

10. **Veïtchii,** Schott. Resembles *A. Lowii,* Hook., in shape and ground-color, but the midrib and primary veins are bordered with gray-green, the secondary veins whitish and the petiole green-striped. Java. B.M. 5497 (as *A. Lowii* var. *picta*).

CCC. *Veins white and lf. blotched and mottled.*

11. **macrorhìza,** Schott. Large, reaching 10 or 15 ft.: lf.-blades 3 ft. long, long-sagittate and pointed, the lobes short and obtuse, margin often somewhat wavy, the midrib very broad and conspicuous, the blotches or patches of green and white (in the var. *variegàta,* G.W. 15, p. 339, which is the common form) very striking. Ceylon. I.H. 8:305.—One of the commonest species. Lvs. sometimes almost white.

CCCC. *Veins dark or purple, or the lf. dark-colored.*

12. **cùprea,** Koch (*A. metállica,* Schott). Fig. 168. Petioles 2 ft. or less long, green; blade ovate and peltate, 18 x 12 in., notched at the base and cuspidate at the point, dark metallic green with darker rib and veins, the under side rich purple. Borneo. B.M. 5190. I.H. 8:283. G. 19:413. F.S. 21:2208–9. Lowe, 60. Gn. 50:336.—One of the best, and common.

13. **Regìna,** N. E. Br. Lvs. thick, ovate-cordate, obtuse or cuspidate, the basal lobes short and nearly or quite obtuse, the ribs and veins beneath pubescent, somewhat fleshy, dark green above with darker veins and brown-purple beneath; petioles terete, pubescent spotted purple. Borneo. I.H. 32:544.—Several cult. varieties and hybrids are in the trade in this country: *A. argỳræa,* Sander, lvs. large, dark green with a silvery sheen, hastate-lanceolate (G.W. 15:342); hybrid of longiloba × Pucciana; *A. bataviénsis,* petiole dark purple, lf.-blade dark green; *A. Chantrièri* (raised by Chantrier Bros., Mortefontaine, France), hybrid of cuprea × Sanderiana, with long wavy lvs., purple below and prominently white-veined (I.H. 35:64. R.H. 1887, p. 465); *A. Chélsonii,* cuprea × longiloba, with lvs. purple below and green above; *A. gìgas,* much like Villeneuvei; *A. intermèdia,* hybrid by Veitch 25 years ago (G. 2:61. G.W. 15, p. 341. F. 1869, p. 80); *A. La Salliàna; A. Luciàna,* Thibautiana × Putzeysi, with lvs. dark green above and whitish veins and margins, purple beneath (I.H. 34:27); *A. mortefontainènsis,* Lowii × Sanderiana; *A. Pucciàna,* Putzeysi × Thibautiana; *A. Sèdcnii,* cuprea × Lowii, with ovate-peltate lvs. purple beneath and white-veined above (I.H. 24:292); *A. Van Houttei.*

The following names are also in our trade: *A. illùstris*=Colocasia antiquorum; *A. Jénningsii*=Colocasia affinis; *A. Jóhnstonii*=Cyrtosperma Johnstonii; *A. Marshállii*=Colocasia Marchallii; *A. violàcea*=Colocasia antiquorum(?).

The following may be expected to appear in the American trade: *A. Augustiniàna,* Lind. & Rod. Lvs. peltate and wavy, green above and below, with pale nerves, the petioles brown-spotted; allied to A. zebrina. I.H. 33:593. New Guinea(?).—*A. Cùrtisii,* N. E. Br. Petioles 3 ft. or less, purple-barred: lf.-blade 20 in. or less, and half as wide, shining green and gray-ribbed above, deep purple beneath. Penang.—*A. Desmetiàna,* Hort. Lvs. elongated, heart-shaped and sinuate; petiole spotted.—*A. éminens,* N. E. Br. Lvs. peltate, the blade 2 ft. or less long and nearly half as broad, purple beneath, green and light-veined above; petioles 5 ft. or less, barred. E. Indies.—*A. grándis,* N. E. Br. Large: lvs. 2 ft. or less long, ovate-sagittate, half as broad, black-green below, bright green above; petioles 4 ft. or less, blackish. E. Indies.—*A. guttàta,* N. E. Br., var. *imperiàlis,* N. E. Br. Lvs. sagittate, acute, 1½ ft. or less long and half as broad, purple beneath, brown-green and dark-blotched above. Borneo. I.H. 31:541.—*A. índica,* Schott. 6 ft. or more, stout and fleshy: lvs. often 3 ft. across, ovate-cordate, bright green on both sides. E. Indies. F.S. 21:2206 (as A. plumbea).—*A. Márgaritæ,* Lind. & Rod. Lvs. slightly peltate, wavy, shining, green with blackish midrib, the veins and brownish petioles pubescent. New Guinea. I.H. 33:611.—*A. marginàta.* Said to have come from Brazil. Lvs. 2 ft. or less long and very broad, slightly wavy, rounded and short-pointed, pale green, striped and mottled with purple; petioles brown-marked.—*A. Micholitziàna,* Hort. Lvs. arrow-shaped, velvety, the margins wavy, the midrib white. Malaysia. G.C. III. 51: Suppl. May 25, p. XVI.—*A. odòra,* Koch. Forming a trunk: lvs. sagittate-ovate, the margin slightly undulate, up to 3 ft. long, on long petioles. J.H. III. 42:393.—*A. plúmbea,* Hort.=*A.* grandis(?).—*A. revérsa,* N. E. Br. Dwarf and compact, the petioles 6 in. long, blade less than 1 ft. long, bright green, with rib and nerves olive-green. B.M. 7498. Philippines.—*A. Rodigasiàna,* André. A.Thibautiana × A. Regina.—*A. Sanderiàna* var. *gandavénsis,* Rod. Lvs. wavy-margined, purple and blotched beneath. I.H. 43:65.—*A. scabriúscula,* N. E. Br. Lvs. spreading, not deflexed, sagittate and not peltate, shining green above and paler beneath. Borneo.—*A. sinuàta,* N. E. Br. Lvs. sagittate and sinuate, dark green above with lighter areas, and whitish green below. Philippines.—*A. spectábilis,* Hort. G.22:171.—*A. Watsoniàna,* Hort.=A. Putzeysi.—*A. Wavriniàna,* Mast. Lvs. erect, toothed, not sagittate, lanceolate and long-pointed, dark green; petioles purple-spotted, winged. G.C. III. 23:243. F.E. 10:886. Gn. 55:183. Celebes.

L. H. B.
GEORGE V. NASH.†

ALÒE (Arabic name). *Liliàceæ,* tribe *Aloíneæ.* Acaulescent or variously caulescent perennial succulents.

Leaves often large, usually crowded in rosettes or along end of st.: fls. red or yellow, often paler-striped, straight, tubular (Fig. 169), with short straight limb, equaled or surpassed by the stamens.—Afr., especially in the Cape region, 1 species about the Medit. and extensively naturalized in all warmer parts of the world, and 1 in China. Plants of the coolhouse, best planted out in a well-drained place in summer, when they flower prettily.

169. Flowers of an aloe.

The generic or scientific name Aloe is a Latinized form of an Arabic name. As an English word it is pronounced in two syllables, thus Al-oe. Popularly this word is loosely used, the common American aloe being *Agave americana,* the commonest "century plant." The "bitter aloes" of commerce is a resinous juice much used as a laxative. The best quality is called "Socotrine or Zanzibar aloes," a product of *A. Perryi,* which was known by the Greeks of the fourth century B.C. to come from the island of Socotra. The "Barbadoes

aloes" is the product of *A. vera*, a species much planted in the West Indies. Genera allied to Aloe are Apicra, Gasteria, Haworthia, Pachidendron, and Phylloma. The group is difficult for the botanist, there being few authentic specimens in the herbaria, because of the large size of the plants, the infrequent flowering, and the difficulty of suitably drying them. Monograph by Alwin Berger in Das Pflanzenreich, 1908, hft. 33.

Propagation is by seed, which usually is not true to name, and by suckers or cuttings well dried-off. Branching for this purpose may be induced by searing the crown of old plants. Hybrids between the different species and with related genera are easily secured and interesting.

170. A good pot plant of aloe, showing the offsets.

Aloes are much cultivated as decorative plants, being amongst the most popular of desert and succulent plants for their stiff, harsh and rugged habit. Fig. 170. They are often grouped about large public buildings, where they emphasize certain architectural features. Large collections are to be seen only in botanic gardens and in the collections of a few fanciers. The largest dealer has nearly one hundred kinds, but grows only five or six kinds in quantity.

Old plants of Aloe will keep healthy for several years in the same pots without a renewal of soil, and flower freely at the same time. The soil most suited to their needs is sandy loam three parts, lime rubble and broken brick one part, with a little decayed manure to strengthen the mixture. Very firm potting is necessary. Drainage is a more important item than soil, and must be perfectly arranged to enable the surplus water to run freely from the soil. Broken bricks are preferable to pieces of pots, large pieces for the bottom of the pot or tub, and smaller pieces above, till the last layer is quite fine. Some of the species need freer rooting conditions than others. *A. ciliaris* will grow from 5 to 7 feet in a season. *A. abyssinica* is of robust growth, and differs from most others in the color of the flowers, which are pure yellow, the others being mostly orange and orange-scarlet. *A. plicatilis* makes an ornamental tub plant when 4 or 5 feet high. Except during the period in which the species are in active growth, they need very little water, the principal idea being to keep the soil sweet and porous even when in growth. At all times the air of the house should be as dry as possible, full sunshine not hurting them. Propagation is by seeds, suckers and cuttings. The arborescent kinds should be rooted after they have completed growth. Dust over the cut part of the cutting with powdered charcoal and dry in sunshine before putting it in to root. Insert singly in as small pots as they will go into, and plunge in a sand-bed. Very little moisture is necessary while rooting. (G. W. Oliver.)

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A. *Lvs. clustered, rather few and thin, flaccidly erect, linear, concave, smooth, finely serrulate: st. very short: infl. unbranched; fls. oblong or narrowed upward; stamens included.* (*1–4.*)

B. *Raceme short; pedicels elongated; fls. with distinct segms.*

C. *Lvs. 2-ranked.*

1. **Coöperi,** Baker (*A. Schmidtiàna*, Regel). Somewhat cespitose: lvs. 1–2 x 12–40 in., faintly striate, somewhat white-blotched: infl. 1–2 ft. high; fls. nodding, 1¼–1½ in. long, yellowish or greenish white, rosy at base, with distinct green-tipped segm. Cape. B.M. 6377. Gt. 970. Lyon Hort. 22, p. 305. Wood & Evans, Natal Pl. 41.

CC. *Lvs. spirally arranged.*

2. **micracântha,** Haw. Lvs. ½ x 18 in.: infl. 1 ft. high; fls. nodding, 1¼–1½ in. long; red, the distinct segm. green above or tipped and lined with green. Cape. B.M. 2272. Salm, Aloe §21, f. 1.

3. **mínima,** Baker. Lvs. ¼ x 6–8 in.: infl. 6–12 or even 30 in. high; fls. spreading, ¾–1¼ in. long, greenish white or the distinct segm. rosy tinged. Cape. Hook. Icon. 2423. Wood, Natal Pl. 338.

BB. *Raceme elongated; pedicels short; fls. spreading or ascending: lvs. spirally arranged.*

4. **kniphofioìdes,** Baker. Lvs. ¼ x 12–15 in.: infl. 2 ft. high; fls. ascending, 1¼ in. long, pale red, with very short segm. and long tube. Cape. Hook. Icon. 1939.

AA. *Lvs. spirally rosulate* (*3-ranked in A. variegata*), *fleshy, acute or pungent: stamens little protruded.* (*5–26.*)

B. *Plants small: lvs. 3–8 in. long: st. never tall: infl. racemose; pedicels long; fls. nearly cylindrical.*

C. *The lvs. bristle-tipped, soft-toothed and warty: raceme rather short.*

5. **aristàta,** Haw. (*A. longiaristàta*, R. & S.). Lvs. erect, triangular-lanceolate, ¾ x 3–4 in., with a whip-

like apical thread, white-warty in transverse lines on the back and with rather small close white marginal teeth: infl. 1–1½ ft. high; fls. 1¼ in. long, reddish yellow, the moderately long tube somewhat constricted above the base. Cape. Gt. 1883, p. 151. Salm, Aloe §15, f. 7. Lyon Hort. 22, 307. Berger 61.—In aspect resembling Haworthia. Varies in a nearly smooth-lvd. form, var. **leiophýlla**, Baker, and a gray-lvd. form with 2-ranked tubercles, var. **parvifòlia**, Baker. Hybrids are: *A.* × *prorúmpens*, Berger, *A.* × *Beguínii*, Hort., *A.* × *perféctior*, Berger, *A.* × *Chludòmii*, Beguin, *A.* × *Lapaixii*, Radl., *A.* × *Qúehlii*, Radl., *A.* × *Nowátnyi*, Radl., *A.* × *Bedinghaùsii*, Radl., and *A.* × *Simoniàna*, Deleuil. All are known or believed to be crosses with species of the related genus Gasteria.

CC. *The lvs. not bristle-tipped, rather coarsely toothed, sometimes warty.*

D. *Teeth pale, racemes rather long.*

6. **hùmilis,** Haw. (*A. perfoliàta hùmilis*, Linn.). Lvs. suberect, rather incurved, triangular-lanceolate, ¾ x 4 in., gradually acute, somewhat striate, sharply white-tuberculate, at least on the back, and with rather close large white marginal teeth: infl. 1½–2 ft. high; fls. 1½ in. long, red or yellowish, the green-tipped segm. distinct nearly to the base. Cape. Salm, Aloe §15, f. 1.—With somewhat the habit of Haworthia. Varies from the narrow green-lvd. type into glaucous forms of this, with rather thicker lvs., var. **incúrva**, Haw. (*A. incúrva*, Haw.), B.M. 828, Salm, Aloe §15, f. 3, and rather thin, more concave lvs., var. **echinàta**, Baker (*A. echinàta*, Willd.), Salm, Aloe §15, f. 2., Berger 64, 65, and one with purplish lvs., var. **macilénta**, Baker; as well as a broader-lvd. glaucous large form, var. **suberécta**, Baker (*A. suberécta*, Haw. *A. acuminàta màjor*, Salm-Dyck), which is sometimes white-mottled, var. **semiguttàta**, Haw.; a moderately large broad-lvd. form, var. **acuminàta**, Baker (*A. acuminàta*, Haw., *A. suberécta*, Haw.), B.M. 757; and a small blue-glaucous form with closer prickles and smaller warts, var. **subtuberculàta**, Baker (*A. subtuberculàta*, Haw.). Hybrids are: *A.* × *insìgnis*, Brown (*A. humilis* × *A. drepanophylla*), *A.* × *spinosíssima*, Hort. (*A. humilis echinata* × *A. arborescens pachythyrsa*), *A.* × *cyànea*, Hort. (*A. hùmilis incurva* × *A. arborescens frutescens*), *A.* × *Todàri*, Borzi, (*A. Todari præcox*, Borzi,) *A.* × *Grusònii*, Henze, Monatschr. Kakteenk. 11, p. 57. (*A. humilis* × *A. Schimperi*), *A.* × *Hénzei*, Hort. (*A. Grusonii* × *A. variegata*), and perhaps *A.* × *lætecoccínea*.

7. **vìrens,** Haw. Lvs. curved, spreading, triangular, about 1 x 8 in., somewhat mottled or also lined, not warty, with rather distant, coarse, white, marginal teeth: infl. about 2 ft. high; fls. 1½–2 in. long, red, the tube longer than the paler green-tipped sometimes very short segm. Cape. B.M. 1355. Salm, Aloe §15, f. 8. Berger 62, 63. Journ. et Fl. des Jard. 1832, 20.

DD. *Teeth dark: racemes short.*

8. **praténsis,** Baker. Acaulescent: lvs. erect-spreading, 1–2 x 4–6 in., acute, striate, with large chestnut or blackish prickles on the margin and toward the top of the back: infl. 1½ ft. high; fls. 1¼–1½ in. long, yellowish red, the distinct segm. green-tipped. Cape. B.M. 6705. Berger 67.

9. **glaùca,** Mill. (*A. rhodacántha*, DC.) Shortly caulescent: lvs. erect-spreading, 1½–2 x 6–8 in., acuminate, somewhat white-lined, with close strong reddish prickles on margin and back at apex: infl. 2–2½ ft. high; fls. 1¼ in. long, red, the nearly distinct segm. somewhat paler and green at tip. Cape. Salm, Aloe §17, f. 2. DC., Pl. Gr. 44. B.M. 1278.—This pale-lvd., always strongly armed species varies in a distinctly caulescent less glaucous form with even larger prickles, var. **muricàta**, Baker (*A. muricàta*, Schult., *A. glaùca spinòsior*, Haw.).

CCC. *The lvs. not bristle-tipped or warty, minutely toothed or merely rough-edged: pedicels rather short.*

10. **variegàta,** Linn. (*A. punctàta*, Haw.). At length with a leafy st. 6–9 in. high: lvs. green, ascending, in 3 close oblique ranks, about 1 x 2–5 in., triangular, v-shaped, abruptly acute, crossed by bands of elongated white blotches, edged and keeled by cartilaginous warty, or toward the tip serrate rather than toothed, white borders: infl. about 1 ft. high; fls. 1¼–1½ in. long, red, the green-nerved segms. rather shorter than the nearly cylindrical tube. Cape. B.M. 513. DC., Pl. Gr. 21. Salm, Aloe §20, f. 2. Berger 68. G.Z. 4:92. Wien. Ill. Gart. Zeit. 1904, p. 122. Gt. 29, p. 25. Mordaunt, Hb. 2:90. Lyon Hort. 21, p. 62; 22, p. 307. Deutsch. Tiefsee-Exped. 2:124. F.E. 8:98.—In habit resembling Haworthia. Varies in a form with broader lvs. with smaller less banded blotches, var. **Hawórthii,** Berger. Hybrids: *A.* × *smarágdina*, Hort. (*A. variegata* × *Gasteria candicans*?), *A.* × *Rebùtii*, Hort. (*A. variegata* × *Gasteria*, sp.), *A.* × *Desmetiàna*, Hort. (*A. variegata* × *humilis echinata minor*), *A.* × *imbricàta*, Hort. (*A. variegata* or *A. serrulata* × ?), *A.* × *mortolénsis* (*A. variegata* × *Gasteria acinaciformis*).

11. **serrulàta,** Haw. (*A. perfoliàta serrulàta*, Ait.). Fig.171. At length short-std.: lvs. somewhat glaucous, rather spirally arranged and spreading, 2 x 8 in., ovate, nearly flat above, with scattered elongated white blotches and serrulate white margin and keel: infl. 1½ ft. high; fls. 1½–2 in. long, red, the green-nerved segms. scarcely equaling the somewhat constricted tube. Cape. B.M. 1415. Salm, Aloe §20, f. 1. Berger 68. Hybrids: *A.* × *Hóyeri*, Radl. ("*A. serrulata* × *Lomatophyllum borbonicum*"?).

BB. *Plants moderately large: lvs. 6 or 8 to mostly 12–20 in. long, smooth: st. never tall: infl. usually branched on strong plants; fls. saccate at base, then constricted, or in the last two less saccate, and widened above the constriction; filaments little if at all exserted.*

C. *The lvs. unarmed: infl. compoundly corymbose, with very short racemes.*

12. **striàta,** Haw. (*A. paniculàta*, Jacq. *A. álbocíncta*, Haw.). Nearly simple: lvs. upcurved-spreading, 4–6 x 15–20 in., triangular-oblong, pale or reddish, somewhat pruinose, striate, with entire white cartilaginous margin: infl. 2–3 ft. high, ample; fls. 1¼ in. long, red or yellowish, the pale-tipped segms. much shorter than the tube. Cape. Jacq. Fragm. 62. G.C. III. 36: 423. Berger 69.—Varies in a form with red-margined lvs., var. **rhodocíncta,** Hort. (*A. Hanburiàna*, Naudin), G.W. 3, p. 553, and a form with white-blotched lvs., var. **oligospeìla,** Baker, B.M. 5210. Hybrids: *A.* × *Schimperi*, Tod., Hort. Pan. 16; *A.* × *Bortiàna*, Terr.; *A.* × *Schœnlándii*, Baker; *A.* × *Páxii*, Terr.; *A.* × *Lýnchii*, Baker, G.C. III. 29: 199; *A.* × *Derbétzii*, Hort.; *A.* × *leptophýlla*, Brown, B.M. 7624, Berger 70, and a narrower-lvd. form of it, var. **stenophýlla,** Baker. Unnamed hybrids with *A. saponaria* are known, and *A.* × *Schimperi* has been recrossed with *A. striata*.

171. Aloe serrulata. (No. 11.)

CC. *The lvs. toothed: infl. simply corymbose, or unbranched when poorly developed.*

D. *Racemes short.*

13. **saponària,** Haw. (*A. perfoliàta saponària*, Ait. *A. saponària mìnor*, Haw. *A. dísticha*, Mill. *A.* × *maculòsa*, Lam. *A. umbellàta*, Salm.-Dyck. *A. umbellàta mìnor*,

DC.). Cespitosely clustered: lvs. ascending or spreading, lance-oblong, acuminate, 2 x 6–8 in., often reddish, glaucous, faintly striate, with pale blotches more or less in transverse bands, the large, marginal, confluent teeth brown: infl. 1½–2½ ft. high, commonly branched; fls. 1½–1¾ in. long, red, the paler more or less green segms. much shorter than the tube. Cape. Wood & Evans, Natal Pl. 100. B.M. 1460. DC., Pl. Gr. 98, Salm, Aloe §23, f. 1. Berger 71, 72. Lyon Hort. 22, p. 305. Lam., Encycl. 236.—Varies in a dwarf form with lvs. scarcely 4 in. long, var. **brachyphýlla,** Baker, and a larger greener-lvd. form, var. **latifòlia,** Haw. (*A. latifòlia,* Haw. *A. saponària màjor,* Linn. *A. umbellàta màjor,* DC.) Salm, Aloe §23, f. 3. B.M. 1346.

DD. *Racemes more elongated.*

14. **macracântha,** Baker. Simple, becoming caulescent: lvs. recurving, lance-oblong, 3–5 x 12–18 in., striate and irregularly somewhat white-blotched, with large, yellow-brown, distinct marginal teeth: infl. 1–2 ft. high; fls. 1¾ in. long, greenish yellow or orange, the segms. half as long as the tube. Cape. B.M. 6580.

15. **zebrìna,** Baker (*A. platyphýlla,* Baker. *A. Lugardiàna,* Baker. *A. Baùmii,* Engl. & Gilg. *A. bamangwatênsis,* Schoenl.). Somewhat clustered: lvs. erect-spreading with recurved acute tips, 2½ x 6–12 in., lance-oblong, often reddish, dull, at first pruinose, striate and with elongated pale blotches more or less in transverse bands, the sinuate margin with confluent large red- or brown-tipped teeth: infl. 3–4 ft. high; fls. 1¼ in. long, red, the nerved segms. shorter than the tube. Trop. Afr. Baum, Kunene-Sambesi Exped., 90. G.C. III. 35: 226. B.M. 7948. Berger 75.

16. **macrocárpa,** Tod. Cespitose: lvs. spreading, gradually pointed, 2 x 8–15 in., broadly triangular-oblong, pale, striate, mottled in transverse bands, with irregular, small, confluent, brown-tipped marginal prickles: infl. 2 ft. high; fls. 1 in. long, light red, the nerved segms. shorter than the tube. Trop. Afr. Tod., Hort. Pan. 9. Berger 76.—A larger Abyssinian form, with fls. becoming 1¼ in. long, is var. **màjor,** Berger.

17. **Greênii,** Baker. Lvs. spreading, concave, acute, 3 x 15–18 in., lance-oblong, glossy green, striate and with elongated pale blotches confluent in irregular cross-bands, the sinuate margin with confluent, moderately large, frequently paired, brown upcurved teeth: infl. 1½–4 ft. high; fls. 1–1⅛ in. long, dull red, the segms. much shorter than the tube. Natal. B.M. 6520.

18. **obscùra,** Mill. (*A. perfoliàta obscùra,* Ait. *A. saponària obscùra,* Haw. *A. pícta,* Thunb. *A. pícta màjor,* Willd. *A. maculàta,* Desf.). Lvs. in a compact rosette, 2½–3 x 8 in., triangular-lanceolate, green, striate and with scattered small pale blotches, the sinuate, narrowly cartilaginous margin with rather short and close red-tipped teeth: infl. simple or forked, 2½–3 ft. high; fls. 1¼ in. long, red, the nerved segms. about equaling the tube. Cape region. DC., Pl. Gr. 97. B.M. 1323. Salm, Aloe §23, f. 2. Dillenius, Eltham. 15. Allgem. Deutsch. Gart. Mag. 6:17. Hybrid: *A.* × *pseudopícta,* Berger.

19. **commutàta,** Tod. Lvs. as in *A. saponaria* but with somewhat recurved apex and weaker green-based prickles, 1½–2 x 6 in.: infl. few-branched, 3 ft. high; fls. campanulately widened, 1⅛ in. long, light red, the nerved segms. shorter than the tube. Cape region(?). Tod., Hort. Pan. 18. Berger 77.—Varies in a form with the reddish lvs. scarcely ½in. wide and more conspicuously white-banded, var. **trícolor,** Berger (*A. trícolor,* Baker). B.M. 6324.

20. **grandidentàta,** Salm.-Dyck. Lvs. recurved-spreading, 2½–3 x 12–18 in., lance-oblong, pale, striate and with elongated pale blotches confluent beneath into transverse bands, the sinuate margin with rather distant, large, smoky teeth: infl. 2–3 ft. high; fls. 1⅛ in. long, rosy, the segms. about equaling the campanulately widened tube. Cape region. Salm, Aloe §23, f. 4. Berger 77.

BBB. *Plants rather large: lvs. 15–30 in. long, smooth: st. rarely tall (6 ft. in one form of A. Èru): infl. usually simply panicled or subcorymbose; fls. not saccate.*

21. **vèra,** Linn. (*A. perfoliàta vèra,* Linn. *A. elongàta,* Murr. *A. barbadênsis,* Mill. *A. vulgàris,* Lam. *A. flàva,* Pers.). Cespitose, the sts. at length 1–1½ ft. high: lvs. suberect or spreading, gradually narrowed from the base, pale, 2–3 x 12–20 in., irregularly white-blotched and narrow when young and 2-ranked on offsets, the repand margin with weak pale prickles: infl. 2–3 ft. high, often simple; fls. 1 in. long, yellow, the segms. about equaling the oblong tube. Medit. region and intro. generally through the tropics. Fiori & Paoletti, Fl. Ital. 1, p. 206. Sibthorpe, Fl. Græca, 341. Salm, Aloe §18, f. 2. Stephenson & Churchill, Med. Bot., 109. Bentley & Trimen, Med. Pl. 282. Berger 84. —The source of "Barbados aloes." Varies in a large Arabian form with broader lvs., taller infl., and fls. shading into orange, var. **officinàlis,** Baker (*A. officinàlis,* Forsk., *A. rubéscens,* DC.), DC., Pl. Gr. 15; a smaller Asiatic form with red-tinged fls., var. **chinénsis** (*A. índica,* Royle. *A. chinénsis,* Baker), B.M. 6301; and a hardier garden form of this, var. **Lânzæ,** Berger (*A. Lánzæ,* Tod.), Tod., Hort. Pan. 39. Berger 84.

22. **agavefòlia,** Tod. Little caulescent or cespitose: lvs. recurved-spreading, concave, gradually narrowed, rather thin, 3–6 x 18–20 in., with scattered, small, oblong, pale blotches, the margin with large triangular hooked prickles: infl. 3 ft. high, panicled; fls. 1–1⅛ in. long, dull red, the green, pale-margined segms. about equaling the constricted tube. Trop. Afr. Tod., Hort. Pan. 23.

23. **abyssínica,** Lam. (*A. vulgàris abyssínica,* DC. *A. abyssínica Peacóckii,* Baker. *A. Peacóckii,* Berger & Schum. *A. Campéri,* Schweinf.). Scarcely clustered, acaulescent: lvs. at first ascending, gradually narrowed, rather sharp-pointed, 4–6 x 12–30 in., pale, not mottled, with rather small, confluent, deltoid, reddish marginal prickles: infl. 3 ft. high, dichotomously few-branched; fls. 1¼–1½ in. long, yellow or orange, the segms. rather shorter than the slightly narrowed tube. Trop. Afr. Salm, Aloe §18, f. 1. DC., Pl. Gr. 27. B.M. 6620. Berger 87, 88.

24. **élegans,** Tod., differs mainly in having more elongated racemes.

25. **Èru,** Berger (*A. abyssínica,* Baker). St. branched, scarcely 2 ft. high: lvs. recurving, very fleshy, 1½–3 x 16–34 in., pale, somewhat glossy, with elongated white blotches, the repand margin with large reddish-tipped teeth: infl. 3–6 ft. high, dichotomously branched; fls. campanulate, scarcely ¾in. long, yellow or orange, the segms. longer than the slightly constricted tube. Trop. Afr.—Several minor forms occur—**maculàta, erécta, glaùca, párvi-punctàta,**—and two large forms have been described, var. **cornùta,** Berger (*A. spicàta,* Baker, *A. albopícta,* Hort.), Benth. & Trimen, Med. Pl. 284, and var. **Hoókeri,** Berger (*A. abyssínica,* Hook.), B.M. 7712, respectively short-std. and with a trunk 6 ft. high.

26. **Pérryi,** Baker. Trunk about 1 ft. high, simple: lvs. spreading, gradually narrowed or acuminate, 2–2½ x 15 in., pale green or reddish, somewhat striate but not mottled, the margin with rather small and close brown-tipped prickles: infl. 1½ ft. high, somewhat panicled; fls. 1 in. long, reddish becoming yellow, the green-tipped segms. much shorter than the slightly constricted tube. Socotra. B.M. 6596.—This is now held to be the source of "Socotra aloes," long attributed to *A. succotrina.*

AAA. *Lvs. rather numerous, spirally arranged on a lengthened st., acute or pungent.* (*27–39.*)

B. *The lvs. rather separated, not armed on the back.*

C. *St. weak: lvs. thin, finely prickly on the margin, distinctly separated, with perfoliate striate sheaths: infl. short, racemose.*

27. **ciliàris,** Haw. St. elongated, scrambling, more or less verticillately branched: lvs. elongated lanceolate, striate, coarsely white-denticulate, spreading, about 1 x 3–6 in.: infl. 6–8 in. high; fls. 1⅛ in. long, bright red, the greenish segms. much shorter than the cylindrical tube; stamens little protruding. Cape. Salm, Aloe §25, f. 1. Berger 9, 97. Henslow, S. Afr. Pl. p. 269. —Varies into a smaller-lvd. form with nearly entire lf.-bases and smaller fls., var **Tídmarshii,** Schoenl., and a form with broader lvs., var **Flánaganii,** Schoenl. Hybrids: *A.*×*de Lætii,* Radl. (*A. ciliaris* × *succotrina*).

28. **striátula,** Haw. (*A. Macòwanii,* Baker. *A. aurantìaca,* Baker). Resembling *A. ciliaris:* lvs. longer, narrowly triangular, minutely denticulate: fls. from reddish becoming yellow or orange, with longer segms. and long-protruding stamens. Cape. Monatsschr. f. Kakteenk. 16, p. 4. Berger 99, 100.

CC. *St. stouter: lvs. rather fleshy and close: infl. taller, panicled.*

29. **Hildebrándtii,** Baker. St. slender, elongated: lvs. lanceolate-attenuate, 2 x 6–9 in., somewhat thick, glaucous, sometimes white-blotched as are the short sheaths, with rather small yellow marginal teeth: infl. 1½ ft. high, nearly sessile; fls. 1 in. long, red with more or less yellow- or green-marked segms. about equaling the somewhat constricted tube. Trop. Afr. B.M. 6981. Berger 104.

30. **inérmis,** Forsk. (*A. Líntii,* Baker). St. short: lvs. recurved-spreading, gradually narrowed, 2 x 12 in., fleshy, very pale green or reddish, blade and sheath mottled with white at least when young, entire: infl. 2–3 ft. high, open; fls. 1 in. long, rosy, with green-lined yellowish segms. shorter than the somewhat constricted tube. Arabia. B.M. 7448. Berger 105.

BB. *The lvs. more fleshy, with short, nearly concealed sheaths: infl. often panicled.*

C. *Racemes elongated: lvs. not armed on back.*

31. **Kírkii,** Baker. St. short: lvs. crowded, lanceolate-acuminate, 2 x 9–12 in., somewhat thick, glossy, green or reddish, with rather coarse confluent reddish marginal teeth: infl. 2 ft. high; fls. 1⅛ in. long, light red with yellowish base and greenish segms. shorter than the cylindrical tube. Zanzibar. B.M. 7386.

CC. *Racemes short: lvs. more or less armed on back as well as margin.*

D. *Erect: lvs. elongated.*

32. **soròria,** Berger. Lvs. elongated, triangular, 2½ x 18 in., dull green, brown-striate, with variable whitish marginal teeth alternately larger and smaller: infl. about 2 ft. high; fls. 1⅛ in. long, light red, with segms. longer than the tube. Cape.

DD. *Prostrate: lvs. short and broad: infl. often forked.*

33. **mitrifórmis,** Mill. (*A. xanthacántha,* Salm-Dyck). Fig. 172. Lvs. upcurved, ovate, acute, 2–3 x 4–6 in., glaucous, somewhat prickly toward the tip beneath, with large and strong yellow or brown marginal teeth: infl. 1 ft. or more high; fls. 2 in. long, bright red with recurving, paler, nearly distinct segms. Cape. DC., Pl. Gr. 99. B.M. 1270. Salm, Aloe §24. f. 3. Berger 108.—Very polymorphic, the broad-lvd. typical form, with dorsal teeth on the keel only, varying into a form with smaller marginal teeth, those on the back continuing to the apex, var **pachyphýlla,** Baker; another, in which they stop short of the apex, var. **xanthacántha,** Baker (*A. xanthacántha,* Willd.), Salm, Aloe §24, f. 4; and a third with acuminate lvs., var. **Commelínii,** Baker (*A. Commelínii,* Willd. *A. mitrifórmis humílior,* Haw.), Salm, Aloe §24, f. 5: narrower-lvd. forms with short and broad yellow teeth, var. **flavíspina,** Baker (*A. flavíspina,* Haw.), Salm, Aloe §24, f. 2; or long subulate white teeth, var. **albíspina,** Berger (*A. albíspina,* Haw.): and a variant of the type with scattered teeth over the back of the broad lvs., var. **spinulòsa,** Baker (*A. spinulòsa,* Salm), Salm, Aloe §24, f. 6. Berger 109.

34. **nóbilis,** Haw. (*A. mitrifórmis spinòsior,* Haw.). Lvs. lance-deltoid, 2 x 4–6 in., green, somewhat prickly toward the tip beneath, with large, strong, confluent, white marginal teeth: infl. 2 ft. high; fls. 1½ in. long, red, with recurving distinct segms. Cape. Salm, Aloe §24, f. 7. Berger 109.

172. Aloe mitriformis. (No. 33)

35. **dístans,** Haw. (*A. mitræfórmis angústior,* Lam. *A. perfoliàta brevifòlia,* Ait. *A. brevifòlia,* Haw. *A. mitrifórmis brevifòlia,* Sims. *A. mitrifórmis humílior,* Willd.). Branched and prostrately spreading: lvs. ascending, broadly ovate, acute, 2 x 3–3½ in., glaucous, somewhat mottled below and prickly toward the tip beneath, with strong, dark-tipped yellow marginal teeth: infl. 1½ ft. high; fls. 1¾ in. long, red, with recurving greenish segms. about as long as the cylindrical tube. Cape. Salm, Aloe §24, f. 1. B.M. 1362. Berger 107.

AAAA. *Lvs. numerous, elongated, succulent, acute or pungent, spirally crowded at end of the prominent, sometimes tall trunk.* (*36–49.*)

B. *Stamens scarcely protruded: fls. narrow: lvs. smooth.*

C. *Trunk scarcely 4 ft. high: infl. usually racemose.*

36. **succotrìna,** Lam. (*A. soccotrìna,* DC. *A. perfoliàta soccotrìna,* Ait. *A. socotrìna,* Steph. & Church. *A. vèra,* Mill.). Scarcely cespitose, the dichotomously branched st. at length 3–4 ft. high: lvs. falcately upcurved, gradually narrowed, pale or glaucous, sometimes white-blotched toward the base, 1½–2 x 15–20 in., the margin serrate with small connate white prickles: infl. 2 ft. high; fls. 1¼ in. long, light red, the

distinct segms. green-nerved. Cape. DC., Pl. Gr. 85. Salm, Aloe §22, f. 1. B.M. 472. Stephenson & Churchhill, Med. Pl. 110. Berger 113.—Varies in a form with more armed, broader, shorter and straighter lvs., var. **saxígena**, Berger.

37. **purpurâscens**, Haw. (*A. sinuàta*, Thunb.? *A. perfoliàta purpuráscens*, Ait. *A. socotrìna purpuráscens*, Ker. *A. ramòsa*, Haw.). Cespitose, nearly acaulescent: lvs. upcurved, gradually tapered, green, sometimes more or less striate, and white-dotted on the back below, 2½ x 18–20 in., the margin with moderately long connate hooked purplish teeth: infl. 3 ft. high; fls. 1½ in. long, light red, the distinct segms. paler and green-nerved. Cape. Salm, Aloe §22, f. 2. B.M. 1474. Berger 113. Winkler, Pharm. Waarenk. 182.

CC. *Trunk finally 10–20 ft. high: not cespitose.*

D. *Infl. a simple or forked raceme.*

38. **arboréscens**, Mill. (*A. perfoliàta arboréscens*, Ait. *A. arbòrea*, Medikus. *A. fruticòsa*, Lam.? *Catevàla arboréscens*, Medikus. *A. arboréscens Milleri*, Berger). Trunk simple, finally 10–15 ft. high, clothed at top with the withering lvs.: lvs. sinuately spreading, gradually narrowed, dull green, 2 x 24 in., the repand margin with rather long cartilaginous white prickles: infl. elongated; fls. about 1½ in. long, red, with distinct segms. Cape(?). B.M. 1306. Bot. Repos. 468. Berger 115.—Varies into numerous forms: green-lvd., with shorter trunk and long lvs., var. **Ucriæ**, Berger (*A. Ucriæ*, Terr.), Salm, Aloe §26, f. 3. G.W. 10, p. 13. Berger 116, 117; or shorter lvs., var. **viridifòlia**, Berger, —Berger f. 117; or glaucous or blue-lvd., with branched infl., var. **natalénsis**, Berger (*A. natalénsis*, Wood & Evans), Berger 115; or simple infl. with normal fls., var. **frutéscens**, Link. (*A. frutéscens*, Salm-Dyck), Berger 120; or fls. 2 in. long, var. **pachythýrsa**, Berger. Berger 118, 119.

39. **plùridens**, Haw. (*A. Atherstònei*, Baker). Trunk unbranched, finally 8–10 ft. high: lvs. as in the preceding but glossy and somewhat striate, 2½ x 16 in.: infl. branched; fls. 1½ in. long. Cape. Berger 121.

DD. *Infl. a candelabrum-like forking panicle, with upcurved nearly sessile fls.*

40. **africàna**, Mill. (*A. africàna angústior*, Sims. *A. Bolúsii*, Baker. *Pachydéndron africànum*, Haw. *P. princípis*, Haw. *P. angustifòlium*, Haw.). Trunk simple, finally 20 ft. high: lvs. few, rather separated, sinuately spreading or recurved, triangular-oblong, glaucous, 2½–3 x 20–24 in., with rather large triangular horny marginal teeth: infl. 2 ft. high; fls. 1½ in. long, yellow, with segms. shorter than the oblong tube. Cape. Salm, Aloe §27, f. 2. B.M. 2517. Berger 128.

41. **candelàbrum**, Berger, differs chiefly in having the fls. red. Cape.

BB. *Stamens much longer than the rather ample short perianth: not cespitose.*

C. *The lvs. smooth, toothed: infl. racemose or forked.*

42. **rubroviolàcea**, Schweinf. Not branched, scarcely 3 ft. high: lvs. spreading, acuminately triangular, purplish-pruinose, 4 x 24 in., the reddish margin with rather distant curved dark-pointed moderate teeth: infl. often forked, 2 ft. high; fls. 1½ in. long, light red, the segms. rather longer than the tube. N. Afr. B.M. 7882. Berger 122, 123. Hybrids: *A. rubroviolacea* × *A. supralævis*.

43. **Salmdyckiàna**, Schult. Branching, low: lvs. arcuately spreading, gradually tapered, glaucous, 3 x 30 in., the yellowish margin with rather large cartilaginous teeth: infl. 2–3 ft. high, paniculate; fls. 1¼–1½ in. long, red, the green-tipped segms. nearly distinct. S. Afr. Salm., Aloe §27, f. 1. Berger 125, 126.—Varies in a less dense form with stouter trunk, var. **fúlgens**, Berger (*A. fúlgens*, Tod.), Tod., Hort. Pan.

33. Hybrids: *A.* × *Winteri*, Berger (*A. Salmdyckiana* × *A. arborescens frutescens*), *A.* × *Varvàrii*, Borzi (*A. Salmdyckiana* × *A. cæsia?*).

44. **drepanophýlla**, Baker. Trunk slender, simple, 9–12 ft. high: lvs. very narrowly lanceolate-attenuate, glaucous, 1–1½ x 24–36 in., the cartilaginous margin minutely denticulate: infl. 1½ ft. high; fls. scarcely 1 in. long, from red becoming whitish, green-lined, with nearly distinct segms. Cape. Berger 127.

45. **speciòsa**, Baker. Taller, 18–25 ft. high, branching: lvs. very numerous, spreading, gradually tapered, blue, the rosy margin with minute prickles: fls. 1¼ in. long, from rosy becoming whitish, green-nerved, the segms. about equaling the tube. N. Afr. Berger 124.

CC. *The lvs. often armed on one or both faces, toothed: st. nearly simple: infl. paniculately forked.*

46. **supralàevis**, Haw. (*A. Galpìnii*, Baker. *Pachydéndron supralàve*, Haw.). Not branched, 3–6 ft. high: lvs. numerous, upcurved, lanceolate, glaucescent, 4–6 x 20–30 in., prickly on the back only, the marginal teeth rather large, reddish brown: infl. 3 ft. or more high; fls. 1–1⅛ in. long, red-orange, becoming yellower, with segms. longer than the tube. Cape. Salm, Aloe §27, f. 6. Berger 129, 130.—Varies in a form with few if any prickles on the backs of lvs., var. **erythrocárpa**, Berger. Berger 130.

47. **férox**, Mill. (*A. perfoliàta férox*, Ait. *A. muricàta*, Haw. *A. hórrida*, Haw. *A. pseudoférox*, Salm-Dyck. *A. subférox*, Spreng. *Pachydéndron férox*, Haw. *P. pseudoférox*, Haw.). Exceptionally forked, 3–10 ft. high: lvs. numerous, curved, lanceolate, glaucous, becoming reddish, 4–5 x 28 in., more or less prickly on both faces, the purplish margin with rather large red-brown teeth: infl. 4 ft. high; fls. 1¼ in. long, greenish yellow, with smoky-tipped segms. longer than the rather narrow tube. Cape region. B.M. 1975. Berger 131, 132. Salm, Aloe §27, f. 5.—Varies in a whiter-lvd. form with brighter yellow black-tipped fls., var. **xanthostáchys**, Berger.

CCC. *The lvs. smooth, prickly-margined: trunk very large, dichotomously branched, not cespitose: infl. tripartite.*

48. **dichótoma**, Linn. (*Rhipidodéndron dichótomum*, Willd.). Stout flat-topped tree, 25–30 ft. high, repeatedly forked as in *Dracæna Draco:* lvs. nearly flat, recurved-spreading, lanceolate, glaucous, 2–3 x 6–10 in., the yellow-brown margin minutely prickly: infl. 1 ft. or more high; fls. very stout, 1¼ in. long, yellow, with broad, nearly distinct segms. Cape. G.C. 1873, p. 712; 1874, p. 567. Berger pl. 1. and f. 135.—Varies in a smaller-fld. form with shorter stamens, var. **montàna**, Berger (*A. montàna*, Schinz).

49. **Bainèsii**, Dyer. Large flat-topped tree, 30–60 ft. high, copiously branched: lvs. concave, recurved-spreading, elongated, green, 2–3 x 24–36 in., the pale margin with rather small teeth: infl. 1 ft. or more high; fls. 1¼–1½ in. long, yellowish red, with segms. shorter than the tube. Cape region. G.C. 1874, p. 568. B.M. 6848. Berger 136, 137.—Varies in a broader-lvd. form with minute marginal prickles, var. **Bárberæ**, Baker (*A. Bárberæ*, Dyer. *A. Zèyheri*, Hort.), G.C. 1874, p. 568.

AAAAA. *Lvs. rather few, strictly oblong, succulent, 2-ranked, minutely prickly near the very obtuse tip only: st. stout, evident: infl. unbranched; fls. oblong; stamens scarcely protruded.*

50. **plicátilis**, Mill. (*A. dísticha plicátilis*, Linn. *A. linguifórmis*, Linn. *A. flabellifórmis*, Salisb. *Kumàra dísticha*, Medikus. *Rhipidodéndron dístichum*, Willd. *R. plicátile*, Haw.). Somewhat repeatedly forking, 3–10 ft. high, not cespitose: lvs. flat or 2-edged as in Gasteria, ascending, glaucous, 1–1½ x 8–16 in., the narrow cartilaginous margin minutely somewhat denticulate

upward: infl. 1–3 ft. high; fls. 1½–2 in. long, red, with segms. scarcely equaling the tube. Cape. B.M. 457. DC., Pl. Gr. 75, Jacq., Schoenbr. 423. Salm, Aloe §28, f. 2. Medic. 4. Berger 139, 140.

A. Cámeronii, Hemsl. Fls. almost cinnabar-red, passing into yellow toward the top. E. Trop. Afr. B.M. 7915.—*A. Campylosíphon*, A. Berger. Pale yellow fls. E. Trop. Afr.—*A. Chabaùdii*, Schoenl. Allied to A. stricta. Lvs. bordered with small prickles; outer segms. of fls. pale brick-red with whitish wings at apex. Trop. Afr. G.C. III. 38:102.—*A. decòra*, Schoenl. A dwarf species having red fls. tipped with green. S. Afr. G.C. III. 38:3865.—*A. Lástii*, Baker. Fls. pale yellow, greenish at top. Zanzibar.—*A. laxiflòra*, Hort. Very lax arrangement of fls. which are orange-red in lower part and yellow at apex. Cape Colony. G.C. III. 39: 130, desc.—*A. Marlòthii*, A. Berger. Extremely spiny lvs. and nearly horizontally spreading fl.-spikes. British Bechuanaland.—*A. Orpénæ*, Schoenl. Lvs. lined with white spots and markings on both surfaces: fls. red, tipped with white. S. Afr. G.C. III. 38:3865.—*A. pallidiflòra*, A. Berger. A stemless plant: lvs. armed on margins with sharp spines: fls. pale flesh-color. S. Afr. B.M. 8122.—*A. péndens*. A shrubby species: fls. drooping, dull yellowish red. S. Arabia. B.M. 7837.—*A. rubrolùtea*, Schinz. Unbranched st. 8 ft. high or more: lvs. armed or margins with brown deltoid and somewhat hooked spines: fls. bright red. Trop. S. W. Afr. B.M. 8263.

WILLIAM TRELEASE.

ALONSÒA (Alonzo Zanoni, Spanish official at Bogota). *Scrophulariàceæ*. ALONSOA. Tropical American plants, cultivated as annuals in the open, or grown for the attractive winter bloom in pots.

Flowers showy: plant of good habit: corolla very irregular and turned upside down by the twisting of the pedicel, bringing the larger lobe uppermost; stamens 4: lvs. (at least below) opposite or in 3's. —About a dozen species, many of which have been in gardens at one time or another.

Alonsoas are tender, and need protection from frost. Seeds are usually started under glass in the North, although plants bloom well from seeds sown directly in the open. Use only finely prepared soil. For winter bloom, plants are propagated by cuttings or seeds, the latter being sown in late summer.

173. Alonsoa incisifolia. (×¼)

incisifòlia, Ruiz & Pav. (*A. urticæfòlia*, Steud. *Célsia urticæfòlia*, Sims, B.M. 417). Fig. 173. About 2 ft. high, erect: lvs. ovate to oval-lanceolate, long-stalked, deeply cut-toothed: fls. nearly ½in. across, very irregular (somewhat hood-shaped), scarlet, with protruding organs, on slender axillary peduncles; upper limb of corolla 2–4 times longer than calyx; anthers 2–3 times shorter than filaments. Also a white-fld. variety. Peru.—A greenhouse shrub.

Warscewìczii, Regel (*A. incisifòlia* var. *Warscewiczii*, Boiss. *A. grandiflòra*, Hort. *A. compácta*, Hort.). Fls. large, the plant herbaceous or nearly so and treated as a garden annual: lvs. cordate or cordate-lanceolate, double-toothed: calyx-lobes blunt; upper lobes of corolla 4–5 times as long as calyx, and anthers 3–4 times shorter than the crooked filaments, the fls. light cinnabar-red or scarlet-red (and a white variety). Peru.—Apparently the commonest alonsoa in gardens, 2–3 ft., readily grown from seeds as a half-hardy subject; July till autumn; useful also for winter bloom. Plant very bushy, with mostly reddish brown branches.

acutifòlia, Ruiz & Pav. (*A. myrtifòlia*, Roezl). Plant stout but bushy, 20–30 in.: lvs. broad-lanceolate, sharply simple-toothed: pedicels single, glandular hairy (as also the calyx); fls. larger than *A. Warscewiczii*, the limb or lip 3–4 times as long as the calyx; anthers long, several times exceeding the filaments; color of fls. cinnabar-red. Peru. Var. **cándida,** Voss (*A. albiflòra*, Hort.), fls. white. Grown as a garden annual, and also in pots for winter bloom.

lineàris, Ruiz & Pav. (*A. linearifòlia*, Steud. *A. liniflòra*, Hort.). Plant bushy and much branched, 12–20 in.: lvs. linear, pointed, entire or finely toothed, often fascicled or crowded: fls. scarlet. Peru. Var. **grácilis,** Hort. (*A. pùmila*, Hort.), is a smaller graceful form. Cult. as garden annual and also in pots indoors.

A. caulialàta, Ruiz & Pav. Lvs. less cut than in A. incisifolia: fls. smaller: st. 4-angled. Peru.—*A. intermèdia*, L.B.C. 1456=A. linearis.—*A. linifòlia*, Roezl. Plant 1½ ft. or less high: lvs. lanceolate or narrower, entire: fls. bright scarlet. Peru.—*A. Màthewsii*, Benth. Lvs. lanceolate, toothed: fls. scarlet, in terminal racemes. Peru. Greenhouse.

L. H. B.

ALOŸSIA: *Lippia.*

ALPINE PLANTS. In gardening, a term used to designate those plants that thrive in imitated alpine conditions,—in cool places of short-growing season and abundant cold-water supply in the growing and blooming period, and soil conditions approaching those of mountains; in practice, alpine-gardening is a form of rock-gardening.

The cultivation of alpine plants in some parts of the United States must always be attended with difficulty. Wherever, as in the coastal plain region of the Atlantic seaboard, the summers are long, dry and hot, it is almost impossible to cultivate many of the most desirable alpines.

A study of the natural environmental habitats of alpines is the very best way to arrive at really valuable ideas upon their cultivation. Excluding all those alpines of apparently little definite habitat preference, such as the snowdrop, daffodil, poet's narcissus, trailing myrtle, Christmas rose, and Scotch pink, all of which are true alpines, but also tolerant of quite ordinary garden conditions, there is a large class, some hundreds of species, that will grow only in situations approximating their native habitat. These plants, some of which are perhaps the most beautiful flowers in cultivation, grow usually in a region having long, rigorous winters, a growing season averaging 100 to 120 days, and a constant supply of moisture which, on account of its source in the snow above the vegetation-line, is always nearly ice-cold.

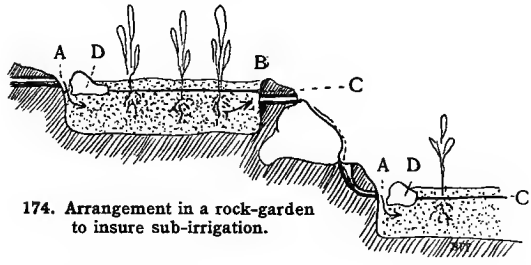
It is true of most of these alpines that they grow among the rocks, and, as we shall see presently, this is a factor that must be reckoned with. Many of them grow in the open sun and are exposed to violent, often bitter, winds. Others again are on north-facing slopes, where the sun rarely, if ever, reaches them. A partial list of alpines given below will show the preference of some of the more common species with regard to the exposure to sunlight.

Localities in the United States and Canada where alpine gardens may be tried with a fair measure of success.

One of the basic requirements of most true alpines is a short growing season. The Atlantic seaboard from Nova Scotia southward, east of the "fall line" (the flat, usually somewhat sandy, regions between the eastern fringe of the Alleghanies and the sea, such as southern Long Island, southern New Jersey and all south of it except parts of Virginia, North Carolina, South Carolina, and Georgia), has an active growing

season of 170 days and upward. This is computed by adding the days from the last frost of spring to the first frost of autumn. At New York, the season is 210 days, at Philadelphia, 220 days, and of course constantly increasing southward.

On account of this long growing season and also because of the dry, hot character of the winds, it is almost impossible, without great expense, to maintain an alpine garden in this region. The same is true of the coastal part of the Pacific coast, and in the Mississippi Valley up to about St. Louis. This is, of course,



174. Arrangement in a rock-garden to insure sub-irrigation.

a general statement, and peculiarly favorable local conditions within the areas specified may be found, where the attempt can be made. But it is extremely doubtful whether any really good alpine garden can be maintained within this area permanently without a great maintenance expense, in the way of constantly supplying new plants, keeping the garden regularly cooled down by water and the like.

As one goes back from the coast, even a few miles, there is a marked change in the climate, and particularly noticeable is the constantly diminishing length of the growing season. Near Hartford, the Highlands of the Hudson, northern New Jersey and Pennsylvania, the growing season averages from 138 to 120 days, more or less. As a general rule it may safely be stated that anywhere east of the Mississippi where elevations of 1,000 feet or greater are found, an alpine garden is permissible except in the southern Alleghanies, where greater elevations must be sought. This length of the growing season is easily computed for all parts of the country, as indicated above; and wherever we find an active growing season of 100 to 140 days, it would be profitable to make an alpine garden. In the East it will be found that the short season is almost always correlated with elevations in excess of 1,000 feet and in the West at several times that altitude.

Position of the alpine garden.

So far as our purpose is concerned, there are three classes of alpine plants: (*a*) those that require full sunlight, (*b*) shade-inhabiting species, and (*c*) those that are apparently indifferent as to exposure. To meet all these conditions within a single garden is not always possible, and a selection of plants must therefore be made, unless one is fortunate enough to have a situation that combines these requisites. As a general rule it is better at some distance from a dwelling, stable, or garage, both architecturally and culturally. No class of plants is quite so wild as alpines, and the more secluded the garden, and the greater the suggestion of sequestered nature the better. A screen of evergreens or other trees, and a northward-facing slope, insuring good drainage, is perhaps the best all-round combination that one could desire. If the garden is at a slight elevation above the immediate surroundings, so much the better; although this is not absolutely essential. Southern or western exposures are to be avoided unless the garden is at least 4,000 feet above the sea in the East, and from 6,000 to 8,000 feet in the West. It should also be arranged so that drainage will not be entirely down through the soil as in ordinary gardens, but rather so

that the water can trickle from the roots of those above to those below. This is often best attained by a judicious use of rocks, which will be considered later.

Making the garden.

Having decided that one lives within the area in which it is safe to begin the installation of an alpine collection, the next most important consideration is to give the plants the requisite local condition. Nearly all of them require good rich soil, at least 18 inches deep, preferably deeper. Even those species that grow in the crevices of the rocks in their native habitat do so not because they "like" such situations, but most probably because no more favorable place is available.

In preparing the soil, it is well to remember that at least one-third of the mixture should be fine rotted leaf-mold mixed with equal parts of loam and sand. The latter is quite necessary in order to insure perfect drainage. It has been stated that some alpines will thrive in situations that approximate our bogs in having a high humic acid content. But most of the species thrive where the drainage is good and the soil is sweet, not sour.

If for no other reason than to insure perfect drainage, it is best to construct the garden in a series of terraces with walks of more or less irregular outline between, as taste and convenience dictate. Avoid all semblance of formality in the arrangement of these terraces, as artificiality or formalism in the alpine garden are quite the least desirable features to be sought.

The terraces, or any modification of them, are best held in place by a more or less free use of rocks. The placing of these requires great skill and taste, as their purpose must be twofold—to add a sense of naturalness to the garden and to make suitable pockets in which to grow the plants. While it is true that many alpines, such as *Thalictrum aquilegiæfolium*, *Clematis recta*, *Aconitum Lycoctonum*, *Digitalis ambigua*, *Polemonium cæruleum*, *Gentiana asclepiadea*, and *Delphinium elatum*, with many others, can be grown without the use of rocks, it is true, on the whole, that most alpines grow better and seem more at home when rocks are part of their environment. Just what part the rocks play in the home economy of the plants is not very well understood, but the readiness with which they conduct the water to the roots, and their tendency to keep the soil cool both suggest themselves as possible benefits.

For such species as *Phlox Douglasii*, *Cassiope Mertensiana*, *Polemonium montrosense*, and all plants of their type whose natural home is at elevations from 10,000 to 12,000 feet, care must be taken to insure almost constant sub-irrigation of cool water. In their native habitats, such plants have their roots constantly in the icy water of the substratum, and any conditions that do not approximate this will make failure almost certain.

An arrangement for insuring this sub-irrigation is figured in Fig. 174, diagramatically. The pocket of soil in the rocks having been filled with the proper soil mixture, the water may be let in at *a*, with a rock just in front of the pipe to insure the water's downward passage (*d*). With the bottom made water-tight by concrete or rocks and clay, and the outlet regulated at *b*, a definite water-level can always be maintained at *c*. The outlet can be arranged as indicated to flow either over the surface of the rock below or in a pipe behind it. If the water for this plan comes from a cool spring, so much the better. The smallest stream of water is sufficient, as it is not the water itself with which one is aiming to supply the plants, so much as the cooling of the soil, rocks and atmosphere that ensues from a gentle flow of water through and around the soil and rocks.

Such measures are not necessary for all alpines, but a few species must be grown under conditions approximated by these methods. The expense of installing and maintaining such construction, however, is relatively great,

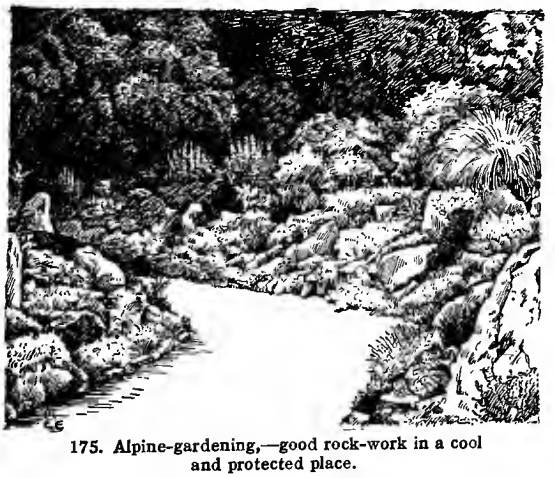
as compared with the simple arrangement of the rocks in pockets, overhanging ledges, nooks, and so forth, which is all that is required for the great majority of alpines. A common and particularly undesirable method of procedure is to tumble a great mass of rocks together, usually utterly without form or definite purpose except to look "artistic," then pile soil amongst them and plant the whole mass. If the idea is constantly kept in mind that the rocks are for use primarily, that they are cultural necessities, and that plants naturally grow between, and among, and often half underneath them,—then the final result is likely to be beautiful, because they are useful and have been placed with an eye to their sole *raison d'etre* in the alpine garden, which is to be a home for alpine plants.

In placing the rocks, indeed in the arrangement of the garden generally, it is better to avoid situations in which the drip from overhanging trees or other objects will fall on the plants. No plants are specially benefited by drip, and alpines, particularly those having tomentose leaves, will suffer from such treatment.

Plants for the alpine garden.

Unfortunately, very few American dealers carry anything like an adequate stock of alpine plants, and only the commonest and best-known species are to be found in the American trade. This has had the effect of restricting the popularity of alpine gardening in this country, and, furthermore, all the alpine gardens of any size have had to seek in Europe for the large variety of species that constitute a well-stocked collection. Many European firms, particularly in England and France, have specialized in alpines. At least 1,000 species are offered by one continental dealer alone. A common but altogether unsatisfactory method, and one that has resulted in numberless failures, is the attempt to import plants direct from these dealers. The time of transit, the highly specialized character of the cultural requirement of alpines, and the lack of attention during transit, all operate to make such shipments costly and usually unsuccessful.

The best and most satisfactory method is to buy seeds of the plants to be cultivated. The initial cost is less than one-fifth and the personal satisfaction in having grown one's stock of plants more than offsets the time spent in this work. The seeds should be imported early in the spring or even in the late winter for those with greenhouse facilities. Sow the seeds in pans or boxes in a light soil of leaf-mold and sand in about equal parts. It is best partially to shade the seeds and very young seedlings for a few days. Pot up when the seedlings are stout enough to stand the transfer, which of course, varies with different species. If it is inconvenient to place them in their permanent home the first year, they may be repotted and then the pots plunged in ashes in the frame. With proper shading from the intense sunlight, and a plentiful supply of cool water so that the ashes are kept moist and cool, they will grow very well under these conditions for the first year. Many of the species can be grown always with this treatment if one has no garden ready for them. The shading for these frames is easily made of ordinary plasterer's lath, the strips being placed about one inch apart and the whole shade arranged so as to be about 2½ feet above the surface of the ground.



175. Alpine-gardening,—good rock-work in a cool and protected place.

Of all the genera cultivated as alpines, the most important are the gentians, saxifrages, sedums, a few dwarf primulas and the pinguiculas. These are much better known abroad than in North America, but many of the best of them can be grown in this country. Among the gentians, Correvon of Geneva classifies them for cultural purposes as follows:

1. Calcareous-soil gentians requiring sun: *alpina, angustifolia, Clusii* and *Kochiana.*
2. Sphagnum-moss species: *bavarica, Rostanii, septemfida.*
3. Marshy-ground species: *angustifolia* (also in group 1) *asclepiadea, Pneumonanthe.*
4. Peaty sand and sandstone with peat in it: *alba, Bigelovii, ciliata, frigida, Parryi, pumila, Wallichiana.*
5. Of indifferent habitat preference: *brevidens, cruciata, dahurica, decumbens, macrophylla, Oliveri, Saponaria, scabra, straminea, Weschniakowi.*

Among the saxifrages only the dwarf, usually perennial, kinds are grown as alpines. In moist, rocky places in the alpine garden the following species of pinguicula will be useful: *P. vallisnerifolia, P. grandiflora,* with purple and blue flowers and *P. alpina* with white flowers. *P. vulgaris* and *P. lusitanica* may be grown in general situations in the "alp."

It is often necessary to make a definite selection of species for a sunny or shady place, as most of our alpines cannot be grown without reference to the amount of sunlight. For those who can arrange only for a rather sunny situation, in which the amount of shade is not sufficient to keep the soil and rocks cool, the following will be found helpful:

ALPINES FOR SUNNY SITUATIONS.

NAME	Color of flowers	Height	Time of flowering
Acæna species	Grown for gray foliage	Creeping, 3–4 in.	
Acantholimon glumaceum	Rose	3 in.	Summer
Achillea argentea	White	4 in.	Summer
A. rupestris	White	3 in.	Summer
A. umbellata	White	6 in.	Summer
Æthionema, various sp.	Pink	About 1 ft.	Summer
Ajuga reptans atropurpurea	For purple foliage	9 in.	
Alyssum, various sp.	Yellow and white	6 in.	Spring
Androsace, various sp.	White and rose	3–6 in.	Spring and summer
Arenaria montana	White	6 in.	Spring and summer
Armeria, various sp.	Rose and white	6–12 in.	Summer
Aster alpinus, vars.	Various, not yellow	About 9 in.	Summer and early autumn
Callandrinia umbellata	Red	6 in.	Summer
Dwarf campanulas	White, blue and purple	3–12 in.	Spring and early summer
Ceratostigma plumbaginoides	Blue	8 in.	Autumn
Corydalis lutea	Yellow	6 in.	Spring
Cyananthus lobatus	Blue	4 in.	Summer
Dianthus (Alpine pinks)	White to rose	5–12 in.	Spring and summer
Draba aizoides	Yellow	3 in.	Spring
Dryas octopetala	White	Creeping	Late spring

ALPINES FOR SUNNY SITUATIONS, continued.

NAME	Color of flowers	Height	Time of flowering
Erigeron Villarsii	Pale violet	12 in.	Summer
Erodium, various sp.	White and red	6–10 in.	Summer
Gentiana, various sp.	Blue	6–18 in.	Spring and summer
Gypsophila, dwarf sp.	White to pink	6–12 in.	Summer
Hedera conglomerata / *H. minima*	Both grown for evergreen foliage	6–8 in.	
Iberis, various sp.	White	6 in.	Summer
Iris, dwarf bearded sp.	Various	6–15 in.	Spring and early summer
Leontopodium alpinum	White	6 in.	Summer and autumn
Linum flavum	Yellow	12 in.	Summer
Macrotomia chioides	Yellow	10 in.	Summer
Morisia hypogæa	Yellow	3 in.	Spring and early summer
Nepeta Mussinii	Blue	12 in.	Summer and autumn
Noccæa alpina	White	3 in.	Spring and summer
Papaver alpinum, vars.	Various	6 in.	Spring
Platycodon, various sp.	Blue	8–15 in.	Spring
Saponaria ocymoides	Red	Creeping	Summer
Silene, various sp.	White and red	5–15 in.	Summer and autumn
Tunica Saxifraga	Pinkish white	3–5 in.	Summer
Veronica incana	Blue	6 in.	Summer
V. cupressioides	Ornamental foliage	10 in.	
Zauschneria, various sp.	Scarlet	12–18 in.	Autumn

The foregoing list is, of course, not a complete one, but it will serve as a guide for the beginner. Many of these will also stand a partially shaded place, some of them prefer such situations, but all of them will grow in the open sunlight if the pitch of the ground is not too great toward the south or southwest.

ALPINES FOR SHADY SITUATIONS.

NAME	Color of flowers	Height	Time of flowering
Adonis, various sp.	Yellow	6–12 in.	Spring.
Anchusa myosotiflora	Blue	12 in.	Summer
Anemone alpina	White	18 in.	Summer
A. sylvestris	White	12 in.	Spring
Aquilegia glandulosa	Blue and white	12 in.	Early summer
A. cærulea	Blue and white	15 in.	Summer
Arenaria balearica	White	2–4 in.	Summer
Auricula, various sp.	Various	4–7 in.	Spring
Dodecatheon sp.	White to purple	12 in.	Spring and early summer
Eomecon chionantha	White	18 in.	Summer
Epimedium, various sp.	Ornamental foliage	6–12 in.	
Erinus, various sp.	White and rose	3 in.	Spring and summer
Galax aphylla	White	12 in.	Summer and autumn
Helleborus niger	White	12 in.	Winter
Iris cristata	Blue	4 in.	Spring
Linaria Cymbalaria	Lilac	3 in.	Summer
L. pallida	Violet	2 in.	Summer
Omphalodes verna	Blue	6 in.	Spring
Ourisia coccinea	Red	9 in.	Spring and early summer
Parnassia palustris.	White	6 in.	Summer
Polemonium humile	Blue	6 in.	Spring and summer
Polygonum affine	Rose	6 in.	Summer
Primula Sieboldii, various forms.	Various	6–9 in.	Spring
Ramondia pyrenaica	Blue	4 in.	Spring
Rodgersia, various sp.	Ornamental foliage	3–6 in.	
Saxifraga Geum (and allies)	Various	12–18 in.	Spring and summer
Shortia galacifolia	White	6 in.	Spring
Soldanella alpina	Blue	4 in.	Spring
Thalictrum minus adiantifolium	Ornamental foliage	6–12 in.	
Trillium, various sp.	White and pink or purple	6–8 in.	Spring

ALPINES FOR SHADY SITUATIONS, continued.

NAME	Color of flowers	Height	Time of flowering
Uvularia grandiflora	Yellowish green	12 in.	Summer or late spring
Vancouveria hexandra	Ornamental foliage	6–8 in.	
Viola, various sp.	Blue and white	3–9 in.	Spring
Waldsteinia fragarioides	White	3–6 in.	Spring

To these may be added the native species that grow naturally in America at elevations in excess of 1,500 feet, such as *Coptis trifolia, Cornus canadensis, Clintonia borealis, Tiarella cordifolia, Trillium grandiflorum, Claytonia caroliniana, Dalibarda repens, Polemonium VanBruntiæ*, various terrestrial habenarias, *Mitella nuda, Arenaria grœnlandica*, and many others.

The plants both for shaded and sunny situations will grow better if there is a liberal top-dressing of leafmold and sand, about half and half, applied each spring. It will be noted that all the plants listed in both lists are perennials. Most natural alpines are of this type, the shortness of the growing season precluding the possibility of the full development of an annual.

For those who wish to go into the growing of alpines more extensively, a partial list of the alpine genera together with an indication of the number of species that are to be found in the principal European trade catalogues is appended. Many additions will suggest themselves as the alpine gardener becomes better acquainted with those listed below and their relatives:

LIST OF THE CHIEF ALPINE GENERA.

The figures indicate approximately the number of species in each genus that are alpines.

Achillea, 5.
Aconitum, 6.
Adenostyles, 2.
Æthionema.
Aira.
Ajuga.
Alchemilla.
Allium.
Allosurus.
Alsine, 6.
Alyssum, 2.
Androsace, 7.
Anemone, 6.
Anthemis.
Aposeris.
Aquilegia, 3.
Arabis, 7.
Arctostaphylos, 2.
Arenaria, 5.
Aretia.
Armeria.
Aronicum, 3.
Artemisia, 4.
Asplenium, 6.
Astrantia.
Atragne.
Azalea
Betonica.
Braya, 2.
Bupleurum, 2.
Calamintha.
Calluna.
Campanula, 8.
Cardamine, 2.
Carex, 20.
Centaurea, 3.
Cerastium, 3.
Cerinthe.
Cirsium.
Crepis, 5.
Crocus.
Daphne.
Dianthus, 5.
Doronicum, 2.
Draba, 6.
Dryas.
Epilobium, 4.
Epimedium.
Erigeron.
Eriophorum, 2.
Eryngium.
Euphrasia.
Festuca, 2.
Galium, 3.
Gaya.
Gentiana, 17.
Geranium, 3.
Geum, 3.
Globularia, 2.
Gnaphalium, 4.
Gymnadenia.
Hedysarum.
Helianthemum.
Helleborus.
Heracleum, 2.
Horminum.
Hieracium, 10.
Hypericum.
Hutchinsia.
Iberis.
Imperatoria.
Juncus, 6.
Kobresia.
Laserpitium.
Lasiagrostis.
Leontodon, 4.
Lilium.
Linnæa.
Listera.
Lonicera.
Lomatogonium.
Luzula, 5.
Lychnis.
Malaxis, 2.
Montia.
Möhringia.
Myosotis.
Myricaria.
Nardus.
Nigritella.
Oxyria.
Oxytropis, 7.
Pæderota, 2.
Papaver, 2.
Pedicularis, 5.
Petasites, 2.
Petrocallis.
Phaca, 4.
Phleum, 2.
Phyteuma, 10.
Pimpinella.
Pinus.
Plantago, 3.
Poa, 5.
Polygala, 2.
Polygonum, 2.
Potentilla, 14.
Primula, 12.
Ranunculus, 14.
Rhinanthus.
Ribes, 2.
Rosa, 3.
Rubus.
Rumex, 3.
Sagina.
Salix, 12.
Saponaria.
Saussurea, 2.
Saxifraga, 30.
Scabiosa.
Scirpus.
Sedum, 7.
Selaginella, 2.
Sempervivum, 5.
Senecio, 8.
Sesleria, 3.
Sibbaldia.
Silene, 6.
Soldanella, 4.
Sorbus.
Soyeria.
Stachys.
Stellaria.
Thalictrum, 6.
Trifolium, 6.
Valeriana, 7.
Veronica, 6.
Viola, 5.
Wulfenia.

The literature on alpine-gardening, in English, is very meager. Any good book of the flora of high mountain regions,—and there are a dozen or more excellent

works on the flora of the Alps,—will aid in the way of suggesting new species that may be grown. A good but rather out-of-date book on the making and culture of alpine gardens is A. Kerner's "Die Cultur der Alpenpflanzen." A useful work containing many cultural hints is H. S. Thompson's "Alpine Plants of Europe, with Cultural Hints." The first International Congress of Alpine Gardens met at Naye, Switzerland, in 1904. As yet nothing except administrative reports of this convocation has been published. N. TAYLOR.

ALPÍNIA (Prosper Alpinus, an Italian botanist). *Zingiberàceæ*. Stove herbs, cultivated both for leaves and the racemes or panicles of flowers.

Many-std. leafy plants, with ginger-like rhizomes: fls. in spikes or panicles terminating the leafy sts., often showy; calyx wide-tubular or nearly bell-form, the tube short and the 3 points or parts erect; corolla of 3 parts; stamens reduced to 1 pollen-bearing organ, and 1 or more staminodia, one of the staminodia being showy and longer than corolla and notched or toothed: fr. a 3-celled caps.—About 150 species in Polynesia, Japan,

176. Alpinia mutica.

and E. India. Some of the cult. forms have undoubtedly been referred to Alpinia without knowledge of the botanical characters, and their botanical position is therefore doubtful. Monogr. in Engler, Pflanzenreich, hft. 20 (1904).

Alpinia contains many handsome species, but only a few are common in cultivation. They are tropical plants and require a moist air and a temperature of 55° to 60° F. A mixture of two parts loam, one part leaf-mold, and one part dried cow-manure forms an excellent compost. While growing, they need an abundance of water, and the large-growing kinds require large pots or tubs. After flowering, allow them to rest in heat, but do not dry them off. The plants are propagated by division in the spring. *A. nutans* is grown for its handsome flowers and attains a height of 12 or 13 feet. *A. vittata* is popular on account of its variegated foliage. *A. mutica* has very showy flowers, but is apparently little known in the trade. (Robert Cameron.)

A. *Foliage striped: plants of doubtful botanical position.*

vittàta, Bull (*Amòmum vittàtum*, Hort.). Lower: lvs. distichous, lanceolate, with pale green or creamy yellow bars or stripes between the nerves: fls. red, in axillary spikes. S. Sea Isls. A.F. 8:787. Gn. 4, p. 25.

álbo-lineàta, Hort. A plant 3–4 ft. high, with broad bands of white and pale green on the elliptic-lanceolate lvs.

Sánderæ, Sand. St. ascending: lvs. very short-stalked and 5 in. or less long, 1¼ in. or less broad, tapering both ways, rich shining green, regularly and closely striped in broad bands of white leading from the midrib to the margin. New Guinea. G.C. III. 33:248 (suppl.). 1903. Probably a variegated form of *A. Rafflesiana*, Wall.

trícolor, Sand. St. erect: lvs. oblong-acuminate, 10 in. long, 1¼ in. wide, green with white or creamy yellow stripes. Solomon Isl. G.C. III. 33:249 (suppl.).

AA. *Foliage green, not striped.*

nùtans, Roscoe (*Zerúmbet speciòsum*, Wendl.). SHELL-FLOWER. Striking plant, reaching 10–12 ft., with long, lanceolate glabrous long-veined lvs.: fls. orchid-like, yellow with pink, sweet-scented, in a long, drooping, terminal, spike-like raceme. E. Indies. G.C. III. 19:301. I.H. 43, p. 259. B.M. 1903. P.M. 13:125. R.H. 1861:51.—Fine for foliage masses, and an old favorite. Said to grow 20 ft. high in S. Calif. in rich soil and with plenty of water, and to bloom continuously.

mùtica, Roxbg. Fig. 176. A handsome strong species: lvs. very short-stalked or sessile, long-lanceolate and pointed: fl. with large bright yellow lip veined crimson, the outer segms. oblong and white. *A. mutica*, Hook. f., B.M. 6908, is probably not the *A. mutica* of Roxburgh. E. Indies. Excellent free-flowering species.

Allùghas, Roscoe. Strong, 3½–7 ft.: lvs. sessile or nearly so, lanceolate or linear-lanceolate, short-acuminate, 1½ ft. or less long, 3–4 in. broad: fls. small, crowded, greenish white, the lip cuneate, pink, emarginate. India. Spring.

calcaràta, Roscoe. Slender, 3–5 ft.: lvs. sessile, narrowly linear-lanceolate and attenuate-acuminate: fls. medium in size, greenish white, the lip variegated with red and yellow on a lighter ground. India. Fall.

Many kinds of these interesting ornamental plants are likely to find their way into choice collections. Some of them are as follows: *A. gigantèa*, Blume, reported in S. Calif., very tall, even to more than 20 ft., with very large nodding panicle.—*A. japónica*, once catalogued in U. S., but not known whether it was the *A. japonica* of Thunberg.—*A. longepetiolàta*, coming from W. Trop. Afr., of robust habit, 6 ft.: lvs. elliptic, the uppermost linear, wing-petioled: fls. white or rose in terminal panicle, purple-spotted.—*A. magnífica*, Roscoe=Phæomeria magnifica.—*A. Nieuwenhuizii*, Valet. (*A. borneensis*, Valet.), distinct species, 4–6 ft.: lvs. 2 ft. or less long: fls. purple-lipped, in panicles 12 in. long: fr. large. Borneo.—*A. officinàrum*, Hance. Supplying the "radix Galangæ minoris" of pharmacists, once used as an aromatic stimulant by Arabs and Greeks: rhizome thick, creeping, the st. tuberous at base: lvs. narrowly lanceolate, long-acuminate: fls. white in simple spike, the lip red-nerved. China. B.M. 6995.—*A. pùmila*, Hook. f. Lvs. from rootstock, 6 in. or less, on petioles 2–4 in.: fls. in short spike, 1 in. long, pink, the lip recurved, on a very short scape. China. B.M. 6832. *A. Schumanniàna*, Valet. (*A. fimbriata*, Gagn.). 3–5 ft.: lvs. lanceolate, 18 in. long, 1½ in. broad: fls. purple in spikes, handsome. Formosa.—*A. zingiberina*, Hook. f. 4–5 ft.: lvs. oblanceolate, oblong, cuspidate, 12 in. or less long, 3 in. broad: fls. greenish, the lip white veined crimson, in panicles. Siam. B.M. 6944.

L. H. B.

ALSEUÓSMIA (*alsos*, grove, and *euosme*, fragrance). *Caprifoliàceæ*. A group of 4 species of tender New Zealand shrubs, usually glabrous. Lvs. alternate or opposite, with minute tufts of hair in the axils of the veins beneath: fls. fragrant, green or red, axillary, solitary or in clusters; corolla tubular or funnelform: fr. a purple, many-seeded berry.—Perhaps not cult. outside botanic gardens.

A. macrophýlla, A. Cunn. NEW ZEALAND HONEYSUCKLE. 6–10 ft.: lvs. 3–6 in. long, elliptic or oblanceolate, acute, serrate, or entire, petiolate: fls. in small axillary clusters, drooping, 1½ in. long, creamy with dull red streaks; corolla lobes recurved, toothed, the tube cylindric. B.M. 6951. N. TAYLOR.

ALSIKE: *Clover* and *Trifolium*.

ALSÌNE (Greek for *grove*, where some species grow). *Caryophyllàceæ*. A few species of Alsine are in the market, mostly for rock-gardening. There is much difference among botanists as to the standing of the genus Alsine. Some persons refer it to Arenaria, others make it a tenable name to replace Stellaria, and Pax in Engler and Prantl's Pflanzenfamilien retains it for about sixty species, mostly in the temperate and cold parts of the northern hemisphere, and distinguishes both Arenaria and Stellaria; for the purposes of this Cyclopedia it seems to be desirable to follow the Index Kewensis disposition; and the few cultivated species are therefore accounted for under *Arenaria*.

ALSÓPHILA (Greek, *grove-loving*). *Cyatheàceæ*. Tree ferns, grown in choice large conservatories, and in the open in warm countries.

Alsophilas have simple or forked free veins, round sori, and no indusia. Numerous species are found in the tropical regions of both hemispheres. The species of Alsophila are very similar in appearance to the tree ferns placed in the genus Cyathea and are probably not generically distinct.

177. Pinna of Alsophila australis

Of the different species of alsophila, only one is in general commercial use. *A. australis* is a very graceful and rapidly growing tree fern, with finely divided fronds of a pleasing shade of light green, with the stipes thickly covered with light brown, hairy scales. It is grown from spores, which can be obtained only from old and large specimens, and which, like the spores of most commercial ferns, will germinate very freely if sown on a compost consisting of finely screened soil, leaf-mold and sand in equal parts. To develop a good crown of fronds in old specimen plants which may look starved, the stem may be covered to any thickness consistent with good appearance with green moss, which may be attached with thin copper wire, and which, if kept continually moist, will soon be thickly covered with fine roots. Alsophilas should be grown in a temperature of 60° F., and the soil should never be allowed to become very dry. (Nichol N. Bruckner.)

A. *Lvs. bipinnate; rachises merely fibrillose.*

Rebéccæ, F. Muell. Lvs. ample, from 8 in. or so high; pinnæ 12–15 in. long, with 20–30 pinnules on each side, which are 2–3 in. long and serrate or crenate throughout. Austral. G.Z. 28, p. 2.

AA. *Lvs. tripinnatifid or tripinnate; rachises armed with spines.*

B. *Segms. long, strongly curved; pinnules tapering to a slender point.*

excélsa, R. Br. Lvs. coriaceous, with more or less woolly rachises; pinnæ 6–10 in. wide, with crowded pinnules, which are provided with about 20 pairs of segms. which are strongly curved and more or less enlarged at the ends. Norfolk Isl. and Austral.—Said to have a trunk 60–80 ft. high.

Coòperi, F. Muell. Smaller than the last: rachises with pale brown scales; pinnæ spear-shaped, with linear pinnules 4–5 in. long. Queensland.

lunulàta, R. Br. Lvs. rather thick, herbaceous, from smooth rachises; pinnules close, 5–6 in. long, with 20–30 pairs of segms., which are finely serrate throughout.

BB. *Segms. ½in. or less long.*

australis, R. Br. Fig. 177. Rachises straw-colored; lvs. ample, with primary pinnæ 18 in. long, 6–10 in. wide; pinnules deeply pinnatifid, with segms. broadest at the base, ovate-oblong and sharply serrate. Tasmania and Austral.

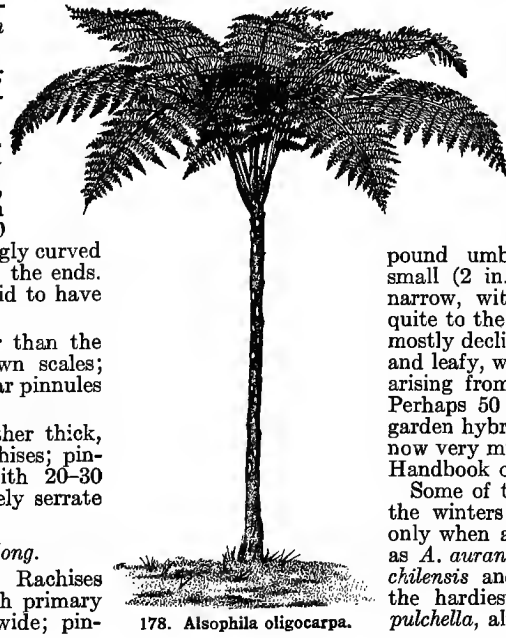
fèrox, Presl. (*A. aculeàta*, J. Smith). Rachises brownish: pinnæ 12–18 in. long; pinnules narrow, 3–4 in. long, ⅓–½in. wide, with 15–18 pairs of segms. which are narrow and slightly serrate. Trop. Amer.

AAA. *Lvs. quadripinnatifid.*

oligocárpa, Fee. Fig. 178. Rachises smooth, grayish straw-colored; pinnules 1½–2 ft. long, the segms. ligulate, deeply pinnatifid, with blunt lobes; sori median, 4–6 on the lower lobes. Colombia.

A. Baroùmba, Hort. Recently intro. Not so elegant as A. Loubetiana, but of interest for its majestic dimensions. Congo Free State.—*A. congoénsis*, Hort. Large, handsome fronds, with prominent yellow midrib: pinnæ deeply and regularly cut.—*A. incàna*, Hort. A magnificent tree fern with black spiny petioles. Congo. R.B. 34:172.—*A. Loubetiàna*, Hort. A decorative tree fern with broad lvs.: rachis hairy brown. S.H. 4:453.

L. M. Underwood.
R. C. Benedict.†



178. Alsophila oligocarpa.

ALSTÒNIA (Dr. Alston, once professor of botany at Edinburgh). *Apocynàceæ*. Two trees of this genus are introduced in southern Florida and southern California for outdoor planting.

Corolla-tube cylindrical, usually swollen at the base, the parts spreading, usually twisted in the bud; anthers inclosed in the tube.—Between 30 and 40 species of trees or shrubs of E. India and Austral., with small white fls. in terminal cymes, and simple entire lvs. in whorls or opposite. *A. scholaris*, R. Br., is the devil-tree or pali-mara of India, the bark of which is medicinal. Trees yield caoutchouc.

macrophýlla, Wall. A tall tree, with milky juice: lvs. 6–12 in. long, 2½–3 in. wide, oblanceolate or elliptic-lanceolate, obtusely acuminate, nerves 16–20 pairs: cymes numerous, the fls. small; corolla-tube glabrous, the throat villous; ovary glabrous. Malaya.

scholàris, R. Br. Tree, 50–90 ft.: lvs. 4–8 in. long, 1–1½ in. wide, coriaceous, usually 4–7 in a whorl, obovate or elliptic-oblong, white beneath; with 30–60 veins: fls. pubescent, subcapitate, ovary hirsute. Wight Icones Ind. Or. 2:422. Rheede Hort. Malab. 1:45.—Intro. by Montarioso Nursery, Santa Barbara, Calif., in 1910. Tropics.

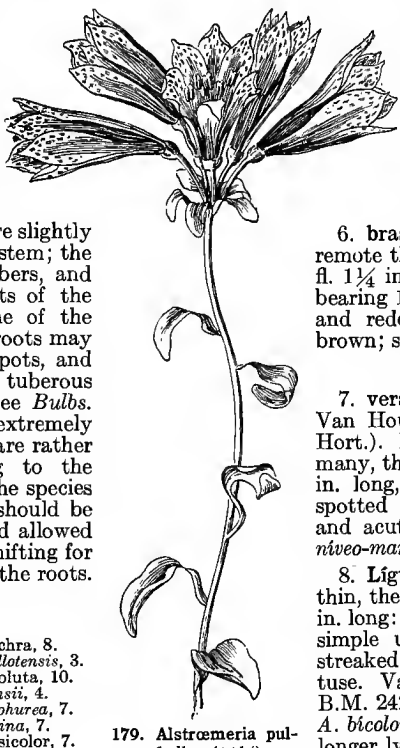
N. Taylor.†

ALSTRŒMÈRIA (Baron Alstrœmer, friend of Linnæus). *Amaryllidàceæ*. Alstremeria. Coolhouse and stove plants, with tuberous roots, treated as bulbs; and some of them also grown in the open for summer bloom.

Showy tall or slender plants with the red, purple or yellow blossoms in simple or compound umbels terminating the st.: fls. small (2 in. or less long), comparatively narrow, with 6 segms., parted nearly or quite to the ovary, often irregular; stamens mostly declined; stigma 3-cleft; sts. slender and leafy, weak, or even disposed to climb, arising from a root of thickened fibers.—Perhaps 50 species in S. Amer. There are garden hybrids. The alstremerias are not now very much grown. Monogr. by Baker, Handbook of the Amaryllideæ.

Some of the alstremerias have survived the winters in Washington of late years only when a heavy mulch has been given, as *A. aurantiaca* and its form *A. aurea*, *A. chilensis* and its forms. Evidently among the hardiest are *A. brasiliensis* and *A. pulchella*, although some of the others have

not been tried. For outdoor planting, alstremerias are at their best in a partly shaded position, and at all times during their growth the roots must have an abundance of water. In fact, there is little use in attempting their cultivation out-of-doors when these conditions cannot be given.—In colder climates, the alstremerias can be grown very successfully by planting out in spring, and, as soon as they die down, lift, and keep over winter in a place from which frost is excluded. An annual lifting, or, when grown in pots, an annual shaking-out, should be given, because they increase to such an extent that the younger and smaller crowns are apt to take the nourishment from the large flowering crowns. The largest ones ought to be separated from the smaller ones, and either grown in pots or planted outside when the proper time arrives. In this way the genus will become much more popular than it now is, either for cutting or for the decoration of the border.—The best soil is largely composed of vegetable humus; when this is not to be had old well-decayed cow- or stable-manure should be incorporated with the soil. When they are planted outside, the tubers should be put deep in the ground, and the soil should be well worked for at least 15 inches. The tubers are slightly egg-shaped, attached to a common stem; the roots are from the ends of the tubers, and also from near the growing points of the crowns.—For greenhouse work one of the best is *A. Pelegrina* var. *alba*. The roots may be potted up in autumn in large pots, and treated as other tender late winter tuberous or bulbous plants are treated. See *Bulbs*. Some of the Van Houtte hybrids are extremely pretty, but, with the others, they are rather unsuitable for pot culture, owing to the peculiar formation of the roots.—The species are easily raised from seeds, which should be sown rather thinly in deep pans, and allowed to remain without pricking off or shifting for the first season; also by division of the roots. (G. W. Oliver.)



179. Alstrœmeria pulchella. (×½)

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A. *Lvs. of fl.-st.* (*or scape*) *broad, oblong or oblong-spatulate.*

1. **pulchélla,** Linn. f. (*A. psittacina*, Lehm.). Fig. 179. Sterile st. a foot or less long, with aggregated petioled lvs.: flowering st. 2–3 ft., with scattered lvs.: fls. in a simple umbel, on pedicels 1–1½ in. long, long funnel-shaped, the segms. unequal, dark red and tipped with green and spotted inside with brown; stamens nearly as long as limb. Brazil. Fig. 179 is of the *A. psittacina*, B.M. 3033.—An old garden plant.

2. **chilénsis,** Cree. CHILIAN LILY. Stout, 2–4 ft.: lvs. scattered, obovate or spatulate, or the upper becoming lanceolate, twisted at the base, fringed, somewhat glaucous: fls. large, rose or red (or varying to whitish), the two lower segms. longer and straighter; umbel with 5 or 6 2-fld. peduncles. Chile.

AA. *Lvs. of fl.-st. lanceolate* (*at least the lower ones*).

B. *Fls. purplish or red.*

3. **Pelegrìna,** Linn. Fl.-st. stout, a foot or less high: lvs. about 30, thin, ascending, 2 in. or less long and ½in. or less wide: fl. 2 in. or less long, lilac, the outer segms. broad and cuspidate, the inner ones spotted red-purple: umbel few-rayed, normally simple, but becoming compound in cult. Also a pure white variety (*A. álba*, Hort.). *A. quilloténsis*, Hort., is a robust cult. form. Chile. B.M. 139. Gn. 46, p. 472. L.B.C. 13:1295.

4. **hæmántha,** Ruiz & Pav. (*A. Simsii*, Spreng.). Fl.-st. 2–3 ft.: lvs. crowded and thin, somewhat stalked, 3–4 in. long and ¾in. or less wide, the upper becoming linear, glaucous beneath: fls. 2 in. or less long, bright red tipped green, the inner ones with red-purple spots on a red-yellow ground; umbel very compound, the branches 4–6 in. long. A white-fld. variety is cult. Chile. B.M. 2353 (as *A. pulchella*).

BB. *Fls. yellow or yellowish.*

5. **aurantìaca,** Don (*A. aùrea*, Hort.). Fl.-st. 2–4 ft. high: lvs. nearly 50, thin, somewhat petiolate, slightly glaucous below, 3–4 ft. long and ½in. wide: fls. 10–30, in a compound umbel, the perianth bright yellow, outer segms. tipped green and inner ones spotted brown.—There is a form with pale, unspotted fls. Chile. B.M. 3350 (as *A. aurea*). Gn. 26: 540. *A. lùtea*, Hort., is probably a form of this species.

6. **brasiliénsis,** Spreng. St. 3–4 ft.: lvs. remote thickish, oblong-lanceolate, 2 in. long: fl. 1¼ in. long, in a 5-rayed umbel (each ray bearing 1–3 fls.), the segms. oblong-spatulate and reddish yellow, the inner ones spotted brown; stamens shorter than segms. Brazil.

AAA. *Lvs. of fl.-st. linear.*

7. **versícolor,** Ruiz & Pav. (*A. peruviàna*, Van Houtte. *A. sulphùrea* and *A. tigrìna*, Hort.). Fl.-st. short (1 ft. or less high): lvs. many, the lower ones about 1 in. long: fls. 1 in. long, in a nearly simple umbel, yellow spotted purple, the segms. all oblanceolate and acute. A marginate 1-fld. form is var. *níveo-marginàta*. Chile.

8. **Lígtu,** Linn. Fl.-st. 1½–2 ft.: lvs. 20–30, thin, the lowermost becoming lanceolate, 2–3 in. long: fls. 1½ in. long, in a nearly or quite simple umbel, whitish, lilac or pale red, streaked purple, the inner segms. often obtuse. Var. **púlchra,** Baker (*A. púlchra*, Sims, B.M. 2421. *A. Flós-Mártinii*, Ker, B.R. 731. *A. bícolor*, L.B.C. 15:1497), has narrower and longer lvs., and all the segms. acute or cuspidate. Chile. Common and variable in cult. *A. Hoòkeri*, Lodd., is a form of *A. Ligtu*. The *A. Ligtu* of B.M. 125 is *A. caryophyllèa*, Jacq., with long-clawed, very unequal segms. in two sets or lips, red and red-striped. Brazil.

9. **violàcea,** Phill. St. 1–2 ft.: lvs. scattered and spreading, 1 in. or less long, those on sterile shoots larger, ovate-oblong and 5-nerved: fls. on forked pedicels in a 5-rayed umbel, 1½–2 in. long, bright lilac, the outer segms. obovate, truncate and with a short cusp, the inner oblong-acute, spotted. Chile.

10. **revolùta,** Ruiz & Pav. Fl.-st. 1 ft. or more: lvs. crowded, linear, 1½ in. or less: fls. 6–12, purplish, ¾in. or less, the segms. oblanceolate-clawed, reflexed or spreading from the middle in full bloom, the inner segms. yellowish and spotted. Chile. L. H. B.

ALTAMIRANÒA (named for Dr. F. Altamirano, late Director of the Instituto Medico Nacional, of the City of Mexico). *Crassulàceæ*. Low, much-branched perennials with the habit and foliage of Sedum, but with the petals united into a distinct tube. On account of the tubular fls., some of the species were first described

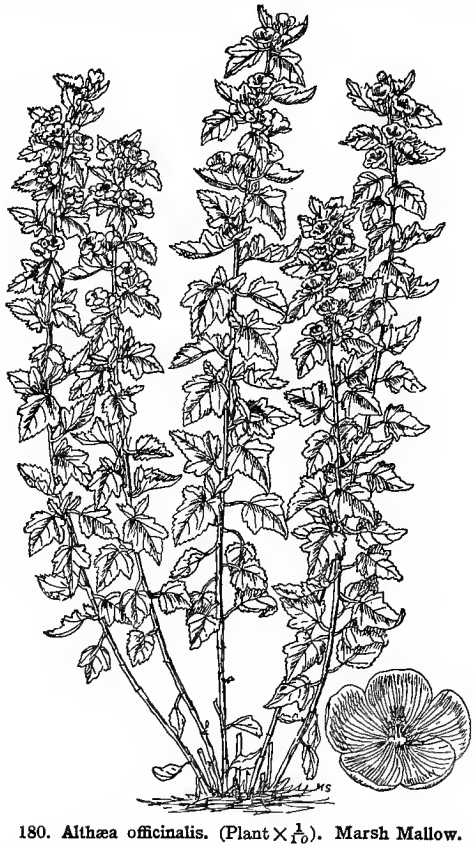
as Cotyledon, with which they have little else in common. None of the species is especially attractive, but all of them develop at the base or on the branches curious rosettes of lvs. Twelve specimens are known, of which 5 have been grown in Washington greenhouses and the New York Botanical Garden. **A. elongàta,** Rose, has puberulent sts. and lvs. and white fls.; **A. calcícola,** Rose, is more or less glaucous, with turgid lvs. and greenish-yellow fls.; **A. Gòldmanii,** Rose, is glabrous, with linear lvs. and pale yellow fls.; **A. Bâtesii,** Rose, is glabrous, with linear lvs. and fls. purplish or becoming so; **A. scopulìna,** Rose, is glabrous, with linear lvs. and pure white fls. J. N. Rose.

ALTERNANTHÈRA: *Telanthera.*

ALTHÆA (Greek, *to cure*). *Malvàceæ.* Tall annual, biennial or perennial herbs, grown in the open garden. The flowering shrubs known as altheas are forms of *Hibiscus syriacus.*

Flowers axillary, solitary, or racemose in the axils or at the summit of the st., with 6–9 bracts below the calyx, but otherwise as in Malva.—About 15 species in the temperate regions of the world.

officinàlis, Linn. Marsh Mallow. Fig. 180. Erect, 3–4 ft., downy: lvs. ovate, often heart-shaped or 3-lobed, frequently undivided, tomentose: fls. 1 in. across, blush or rose, clustered in the axils of the lvs. Perennial,



180. Althæa officinalis. (Plant × $\frac{1}{10}$). Marsh Mallow.

in marshes. E. Eu., and occurring in this country as an escape.—Root used for mucilage and for other purposes; also medicinal. The root of commerce has its brown outer covering removed. Rarely cult., but occasionally escaped in marshes near the coast.

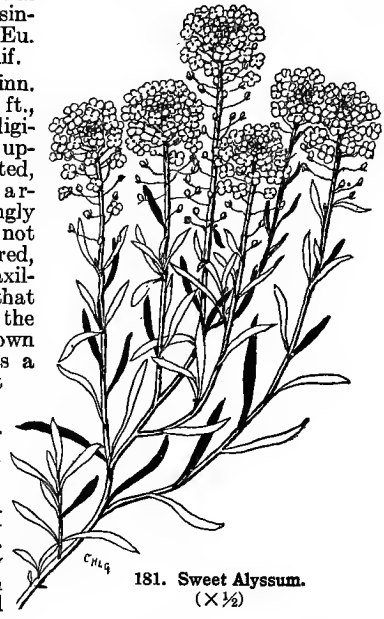
ròsea, Cav. Hollyhock, which see for culture. St. strict and spire-like, hairy: lvs. large and rough, rounded-heart-shaped, wavy-angled or lobed: fls. large and nearly sessile, in a long wand-like raceme or spike, in many forms and colors. Biennial. China. B.M. 3198.

ficifòlia, Cav. Antwerp Hollyhock. Biennial, 3–6 ft.: lvs. 7-lobed, toothed: fl. lemon-yellow or orange, large, in terminal spikes, showy, single or double. Eu. —Grown in Calif.

cannabìna, Linn. Perennial, 5–6 ft., branching: lvs. digitately 5-parted, upper ones 3-parted, the lobes narrow and strongly toothed: fls. not large, rose-colored, on many-fld. axillary peduncles that are longer than the lvs. Eu.—Grown sometimes as a border plant. It yields a fiber. L. H. B.

ALUM-ROOT: *Heuchera.*

ALÝSSUM (classical name). *Cruciferæ.* Low plants with many small clustered flowers, grown in the open and often used in rock-gardens.



181. Sweet Alyssum. (×½)

Plants branching, often tufted: fls. white or yellow, sometimes varying to rose; filaments often notched: fr. a small orbicular pod, with 1 or 2 wingless seeds in each of the 2 compartments; valves of pod nerveless, flattened at the margins.—As many as 100 species in middle Eu., Medit. region and the Caucasus.

The sweet alyssum is one of the commonest annuals, grown both in the open and forced in benches, beds or pots. It is of the easiest culture, either indoors or out. The compact varieties are most prized for pot culture. Under glass, it requires temperature of a carnation house. It will stand considerable frost in the open, and may be sown early; it blooms all summer, and until killed by winter. Useful for window-gardens and baskets. For winter bloom, sow seeds late in August or in September. When blooms begin to fail, cut back the plant, and it will bloom again.

The perennial alyssums require no special treatment. They are usually propagated by dividing the roots; also by cuttings and seeds.

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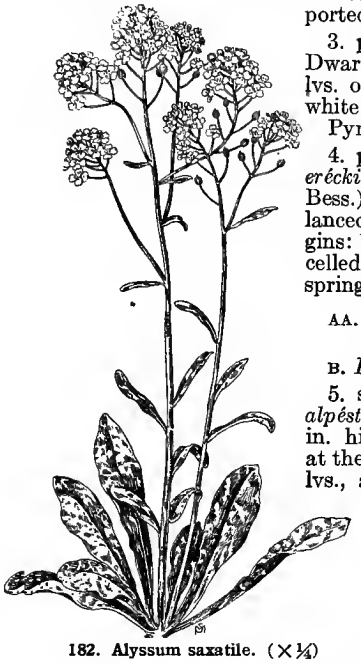
A. *Fls. white; annuals or perennials.*

1. **marítimum,** Lam. (*A. odoràtum,* Hort.). Sweet Alyssum. Fig. 181. A low, spreading, light green annual, with lanceolate or linear entire lvs., tapering to the base, and small honey-scented fls. in terminal clusters, which become long racemes. Eu. Many cult. vars.: var. **Bénthamii** or **compáctum,** a dwarf and compact form, not over 6 in. high; var. **variegàtum,** with pale white-edged lvs.; var. **giganteum,** robust, broad-lvd.; var. **procúm-**

bens, of spreading habit; and various horticultural forms with trade names.

2. **spinòsum,** Linn. A woody-stemmed little perennial, with lanceolate acute silvery lvs., spiny fl. branches, and very small numerous fls. Eu.—Rockwork; 3–6 in. A rose-colored form is reported.



182. Alyssum saxatile. (×¼)

3. **pyrenàicum,** Lapeyr. Dwarf, shrubby, not spiny: lvs. obovate, tomentose: fls. white with brown anthers. Pyrenees. Perennial.

4. **podòlicum,** Bess. (*Schivereckia podólica,* Andrz. & Bess.). Dwarf: lvs. in rosette, lanceolate, 2-toothed on margins: fls. white, short-pedicelled; petals entire. Early spring. S. Russia. Perennial.

AA. *Fls. yellow or orange: perennials.*

B. *Lvs. ½in. or less long.*

5. **serpyllifòlium,** Desf. (*A. alpéstre,* Linn.?). Dwarf (3–4 in. high), somewhat woody at the base, with rough-hoary lvs., and pale yellow fls. in racemes. Eu. Intro. 1892.

BB. *Lvs. mostly 1 in. or more long.*

6. **saxátile,** Linn. GOLDEN-TUFT. Fig. 182. A foot high, woody at base: lvs. oblanceolate or ovate-lanceolate, entire or wavy, hoary-tomentose: fls. golden yellow, numerous, in little compact clusters. Eu. B.M. 159. A.F. 5:37.—Common in rockwork, making a spreading mat, blooming in early spring. There are many forms of this standard rock plant. Var. **compâctum,** Hort., dwarf. Var. **flòre-plèno,** Hort., double-fld. Var. **variegâtum** Hort. (*A. variegàtum,* Hort.), has parti-colored foliage, very attractive.

7. **gemonénse,** Linn. Less hardy than the last: lvs. lanceolate, grayish, velvety: fls. lemon-yellow: st. woody at base. Eu.

8. **rostrâtum,** Stev. (*A. Wièrzbickii,* Heuff.). About 20 in.: lvs. 2 in. long, broad-oblong, pointed, hairy: fls. deep yellow, in dense heads, in summer. Asia Minor.

9. **argénteum,** Vitm. Fig. 183. Dwarf and dense grower, 15 in. or so: lvs. oblong or spatulate, silvery beneath, some of the tufted fls. yellow, in clustered heads, all summer, beginning later than those of *A. saxatile.* Eu.

10. **montânum,** Linn. Tufted alpine, 2–3 in. high, more or less herbaceous, pubescent: lvs. obovate: fls. yellow, fragrant, in a simple raceme. Eu.

11. **Mœllendorfiânum,** Asch. Sts. ascending: lvs. with stellate hairs on both sides, from spatulate to subovate, obtuse: fls. yellow, in elongated many-fld. racemes, the pedicels nearly horizontal and bractless: fr. nearly orbicular. Bosnia.

Many other species of alyssum are likely to be found in choice rock-garden collections. *A. alpéstre,* Linn. 3 in., grayish: fls. yellow, in simple raceme.—*A. atlánticum,* Desf.=A. montanum.—*A. Bertholònii,* Desv.=A. argenteum.—*A. cuneifòlium,* Tenore=A. montanum.—*A dasycárpum,* Steph. Annual: fls. yellow.—*A. diffùsum,* Tenore=A. montanum.—*A. macrocárpum,* DC. Shrubby, somewhat spiny, 8 in.: lvs. oblong, silvery: fls. white.—*A. orientàle,* Ard. 1 ft.: lvs. lanceolate, toothed, downy: fls. yellow, in corymbs.—*A. tortuòsum,* Rupr. 6 in., st. twisted: lvs. narrow, hoary: fls. yellow, in corymbs.

L. H. B.

ALÝXIA: *Gynopogon.*

AMAGLÝPTUS: *Hemiraphis.*

AMANÌTA: *Mushroom.*

AMARABÒYA (native name). *Melastomàceæ.* A genus of only 3 species of tender shrubs from Colombia, which are showy both in foliage and flower. Lvs. large, opposite, sessile, with 3 prominent nerves, brownish red beneath: fls. large, cymose; petals usually 6; stamens 12–15. For cult., see *Pleroma.* Not known to be in American trade. Considered by some as a section of the much larger genus Blakea.

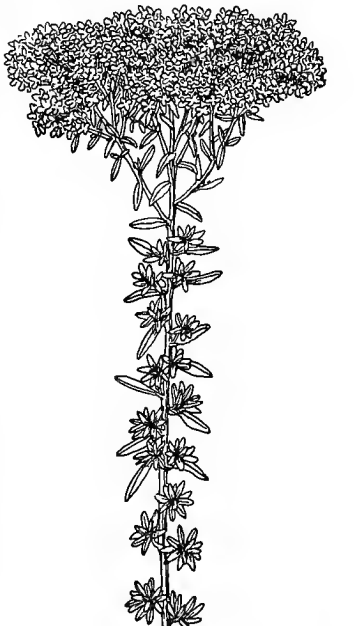
A. ambìlis, Linden. Lvs. 10–12 in. long, 8 in. broad: fls. white, margined carmine; stamens white; style red, exserted. I.H. 34:9.—*A. princeps,* Linden. Fls. carmine; stamens white; styles white. I.H. 34:4.—*A. splèndida,* Linden. Fls. 6½ in. across; petals narrower at the base than in the other species; stamens yellow; style red, exserted. I.H. 34:34.—Perhaps the showiest of all the Melastomaceæ.

N. TAYLOR.†

AMARÁNTUS (Greek, *unfading,* in allusion to the lasting character of the calyx and floral bracts). *Amarantàceæ.* AMARANTH. Coarse annual plants, grown for colored foliage and the showy flower-clusters; related to the cockscomb.

Plants tall and erect or spreading or even prostrate: lvs. alternate, entire, petioled: fls. very small congested in terminal or axillary spikes or glomerules, each fl. subtended by 3 chaffy bracts; petals 0; sepals 3–5, persistent; stamens 2–5: fr. a small 1-seeded utricle.—Some 45–50 species, mostly weedy plants, widely distributed. Some of the pigweeds are of this genus, as *A. retroflexus,* sometimes known as beet-root and red-root; *A. hybridus; A. græcizans* (*A. albus*), one of the tumble-weeds; *A. spinosus; A. blitoides* and *A. Palmeri,* spreading eastward along railroads.

The amaranths are usually planted as open-air annuals, and they require no special treatment. They thrive best in a hot and sunny place. In very rich soil the leaves become very large but usually lack in bright coloring. Seeds may be sown in the open or in frames. The dwarf and compact varieties, which often have beautifully variegated foliage, may be grown in pots or used for bedding. Give plenty of room.



183. Alyssum argenteum. (Plant × ¼)

A. *Lvs. linear-lanceolate, long and drooping.*

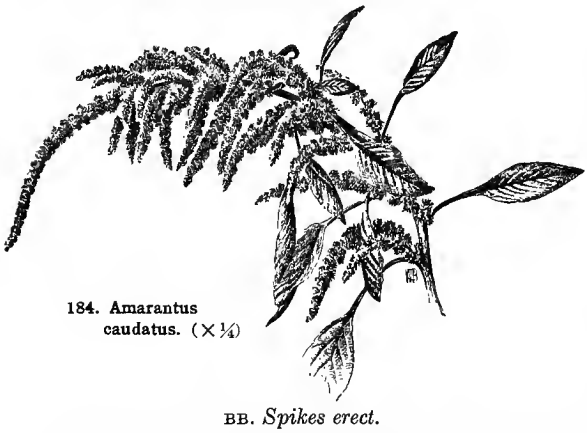
salicifòlius, Veitch. Graceful pyramidal habit, 3 ft.: lvs. 5–8 in. long and ¼in. wide, wavy, bronze-green, changing to orange-red. Philippines. G.C.I. 1871:1550. F.S. 19:1929.

AA. *Lvs. broad, mostly ovate.*

B. *Spikes drooping.*

caudàtus, Linn. LOVE-LIES-BLEEDING. Fig. 184. Tall, robust and diffuse (3–5 ft.): lvs. ovate to ovate-oblong,

stalked, green: spikes red, long and slender, naked, in a long and drooping panicle, the terminal one forming a long, cord-like tail. Also vars. with yellowish and whitish panicles. Tropics. G.W. 6:709.—Common, and an old favorite. Var. **atropurpùreus,** Hort. Foliage blood-red. Var. **albiflòrus,** Hort. Spikes white or greenish white. Var. **gibbòsus,** Hort. Plant not large: fls. red, clustered in more or less separated fascicles or heads.



184. Amarantus caudatus. (×¼)

BB. *Spikes erect.*

hypochondrìacus, Linn. PRINCE'S FEATHER. Tall and glabrous: lvs. oblong-lanceolate, acute: spikes blunt, aggregated into a thick, lumpy terminal panicle, of which the central part is elongated: bracts long-awned.—An old garden plant, with the heavy heads variously colored, but mostly purple. Lvs. usually purple or purple-green. Trop. Amer. Cult. in many forms and sometimes a weed in old grounds. Considered by some to be a form of *A. hýbridus,* Linn. (*A. hýbridus* var. *hypochondriàcus,* Rob.). Var. **sanguíneus,** Hort. (*A. cruéntus,* Hort., not Willd.). Entire plant blood-red. Var. **viréscens,** Hort. Lvs. green above, purplish beneath. Var. **víridis,** Hort. Plant green, except the floral parts. Var. **racemòsus,** Moq. Lateral fl.-branches elongated, light-colored. There are other garden forms.

paniculàtus, Linn. (*A. hýbridus* var. *paniculàtus,* Uline & Bray). St. usually pubescent: lvs. oblong-ovate to ovate-lanceolate, broader than in the last: spikes thinner than in the last, acute or acutish, and in an open, more graceful terminal panicle: bracts sharp-pointed but not long-awned. Trop. Amer.—Common, and sometimes a weed. Var. **speciòsus** (*A. speciòsus,* Sims, B.M. 2227). Stout, large, erect plant (3½–4½ ft.), with sts. and lvs. reddish or purple-green: panicle dark red-purple; handsome. Var. **cruéntus,** Moq. (*A. cruéntus,* Linn., not Hort.). Lateral fl.-branches spreading-nodding, blood-red. Var. **sanguíneus,** Moq. Lateral branches long, slender, often nodding at the tip: fls. and some or all the lvs. blood-red. Var. **flavéscens,** Voss. Panicles large and branched, yellowish or greenish.

gangèticus, Linn. Usually a lower plant, 3 ft. or less and often only 1 ft., with thin, ovate-pointed lvs., and fls. in short, glomerate, interrupted spikes, both terminal and axillary. Tropics.—Very variable. Cult. by Amer. Chinese (Fig. 185) as a pot-herb under the name of hon-toi-moi, with green lvs. (Bailey, Bull. 67, Cornell Exp. Sta.). Various dwarf and compact bedding forms are common. Used more for foliage than for fl.-panicles. Var. **melanchólicus,** Voss (*A. melanchólicus,* Linn.). Lvs. variously colored, sometimes mostly in two colors (*A. bícolor,* Hort.), and also in three colors (*A. trícolor,* Hort.): lvs. long-petioled, broadly to narrowly lanceolate. Here belong the JOSEPH'S COAT group of the bedding amaranths.

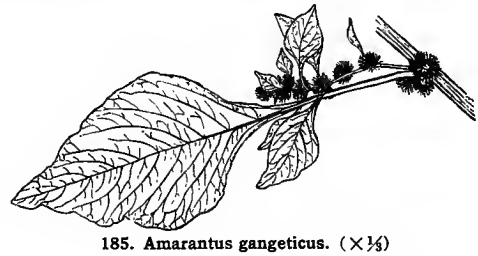
Many Latin-form names are in the catalogues, probably all of which are referable to above species or are hybrids of them; as *A. spléndens,* a form of A. gangeticus var. melancholicus; *A. speciòsus aùreus,* to A. paniculatus var. flavescens; *A. Hénderi,* probably a hybrid with A. salicifolius, or a var. of it, with long-drooping, brown lvs., and tall, pyramidal stature; *A. Górdonii,* or Sunrise, with bronzy banded lvs. and brilliant scarlet lvs. on top; *A. supérbus,* lvs. blood-red above and crimson beneath, probably one of the melancholicus forms; *A. Dússii,* Spreng., with lvs. and fls. bright colored, and suggested as a var. of A. spinosus, which is a smooth weedy species with 2 spines in the axils of the narrow-ovate or rhomb-ovate lvs. —*A. Húttonii,* Veitch=Celosia.

L. H. B.

AMARÝLLIS (classical name). *Amaryllidàceæ.* Summer- or autumn-blooming bulbous plant (March and Apr. at the Cape), the leaves usually appearing later.

Plant stout, producing many strap-like lvs.: fls. large, fragrant in a few- to several-fld. umbel; perianth with a short ribbed tube, the divisions oblong or lanceolate, the filaments distinct and no scale between them; stamens on the throat of the tube: fr. a globose caps., opening irregularly.—One species, from Cape of Good Hope. In gardens, the hippeastrums (winter and spring bloomers) are known as Amaryllis.

In dealing with the culture of amaryllis, it is customary to speak of the genus in its horticultural sense, —to include hippeastrum and related things. Such is the understanding in the following cultural directions. There are two widely differing methods of cultivating the amaryllis to produce showy flowers in the spring months,—the border method and the pot method. Any one trying both of these methods will soon come to the conclusion that they differ not only in method, but in flower-producing results. The first method is to plant the bulbs in a prepared border after they are done flowering, say about the middle of May. The border should have perfect drainage, and, if convenient, be on the south side of a house or wall, fully exposed to the sun during the greater part of the day. The bulbs are set out in rows, necessarily with as little disturbance of the roots as possible, because, if they are bulbs that have undergone similar treatment the previous year, by the middle of May they have made a considerable number of new roots; besides, the foliage also has gained some headway, and may be considered as in actual growth. In planting, carefully firm the soil around the old balls, give one watering, and on the succeeding day, after the surface of the soil has been raked over, cover to the depth of 2 inches with half-decayed cow-manure. With frequent waterings during the summer and the removal of weeds, they will need no more attention until the approach of cool weather, when they should be lifted, sized, and potted; however, at this season, if wet weather has predominated, some of the bulbs will be in a semi-dormant state, while the majority will yet be in active growth. Here is the drawback to this method: The roots are large and fleshy, they



185. Amarantus gangeticus. (×⅓)

take up considerable room in a 6- or 7-inch pot, and the soil cannot be evenly distributed amongst them, neither can it be made as firm as it should be. The result is the partial decay of the roots and leaves, and in the spring, when the flower scapes appear, they are developed at the expense of the bulb, through having insufficient roots to take up nourishment from the soil. The flowers are small, few in number, and do not show what the plant is capable of. Partly to ameliorate these

conditions, the bulbs in active growth at lifting time may be heeled-in on a greenhouse bench until they gradually ripen, taking care that some of the soil is retained on the roots; otherwise the ripening process is altogether too rapid, so that the roots and leaves suddenly lose their robust nature, become flabby, and eventually die. For this method, it can be said that a larger number of bulbs can be grown with less trouble than by the pot method, but neither bulbs nor flowers compare in size with those kept in pots the year round. For the purpose of merely increasing stock, the outdoor method is to be preferred.—Most of the kinds are naturally evergreen; potting under those conditions is best done either after the plants have made their growth in the fall or after they have finished flowering in April. When done in the fall, they are allowed to remain rather dry during the winter; this will keep the soil of the original ball in a sweet condition until the time arrives to start them into growth, which may be anywhere after the first of January, or even earlier if necessary. They will winter all right, and keep their foliage, in a brick frame in which the temperature is not allowed to fall below 45° F. By the beginning of February, in a structure of this sort, they will be showing flower-scapes, and should then be taken to a position in which more heat and light can be given. A weak solution of cow-manure will much help the development of the flowers. When in bloom, a greenhouse temperature, with slight shade, will prolong the flowering period. After flowering, the greatest care should be taken of the plants, as it is from that period till the end of summer that the principal growth is made. A heavy loam, enriched with bone-dust and rotted cow-manure, suits them well.—The seeds of hippeastrums should be sown as soon as ripe, covered very lightly with finely sifted leaf-mold, and, if this shows a tendency to dry too quickly, cover with panes of glass until germination takes place. As soon as the first leaves are developed, they should be potted in the smallest sized pots and kept growing.—In the propagation of varieties, it will be found that the large bulbs make two or more offsets each season; these should not be detached until it is certain that they have enough roots of their own to start with after being separated fom the parent. If a well-flowered specimen clump is desired, the offsets may be allowed to remain attached to the parent; they will, in most cases, flower the second year under generous treatment.—*Amaryllis Belladonna* and the plant known as *A. longifolia* (really a crinum) are hardy in the District of Columbia; *A. longifolia* thrives even in damp, heavy soils, with no protection, and flowers abundantly each year. *A. Belladonna* needs a warm, sheltered spot, with deep planting. This popular autumn-blooming plant succeeds best where it can remain out-of-doors all the year. It seems to thrive in fairly rich sandy loam. A position facing south near the wall of house or by the side of a greenhouse seems to suit its requirements. In rather dry soils where frost does not penetrate deeply, it is not necessary to lift the tubers each year. (G. W. Oliver.)

Belladónna, Linn. Belladonna Lily. Fig. 186. Scape 2–4 ft., with a 2-lvd. dry spathe or involucre just underneath the umbel: fls. on short pedicels, lily-like, short-tubed, and flaring, with pointed segms. 2–3 in. long, and 6 deflexed stamens, fragrant, normally rose-red; scape solid: lvs. strap-shaped, canaliculate and acute. B.M. 733. Gn. 33:268; 47, p. 46; 49, p. 276; 54, p.414. G.C. III. 24:315.—An old favorite, with many Latin-named garden forms. There are varieties ranging from white to red, and varying in shape and size of fls., many of them receiving Latin descriptive names. Var. **purpûrea,** Hort. Fls. purple, at least on the limb. Var. **pállida** (*A. pállida,* Red.), has pale flowers. Var. **blánda,** Voss (*A. blánda,* Gawl. B.M. 1450), is a large form, with white fls., fading to blush. Var. **rôsea perfécta,** Hort. Excellent blooms, satiny rose and white-striped: fls. late, at the time the lvs. appear; the segms. pointed. Gt. 45, p. 443. Var. **spectábilis trícolor,** Hort. Fls. showy, in large umbels, rose-color, white inside, highly perfumed. Gt. 45, p. 358. Var. **máxima,** Hort. Strong grower, with many large rose-colored fls. G.M. 45:303. Var. **Párkeri** (*A. Párkeri,* Hort.). Probably hybrid of *Brunsvigia Josephinæ* and *Amaryllis Belladonna:* umbel circular, with as many as 30 blooms; fls. deep rose with white and orange at base inside, and orange on outside of tube: 3 ft., handsome: also a white-fld. form. G.C. III. 50:211. Gn. 75, p. 460.

See Brunsvigia for *A. gigantea* and *A. orientalis;* Crinum for *A. longifolia* and *A. ornata;* Hippeastrum for *A. aulica, A. equestris, A. fulgida, A. Johnsonii, A. Leopoldii, A. pardina, A. procera, A. Reginæ, A. reticulata, A. vittata;* Lycoris for *A. aurea, A. Hallii,* and *A. radiata;* Nerine for *A. Nerine;* Sprekelia for *A. formosissima;* Sternbergia for *A. lutea;* Vallota for *A. purpurea;* Zephyranthes for *A. Atamasco, A. candida* and *A. erubescens.* The following trade names probably belong to other genera, most likely to Hippeastrum: *A. crocea, A. Graveana, A. macrantha, A. refulgens.* L. H. B.

AMASÒNIA (after Thomas Amason, early American traveler). *Verbenàceæ.* About a half-dozen species of under-shrubs of Trop. Amer. Fls. yellow or sulfur-colored in racemose or paniculate clusters; calyx 5-cleft; corolla 5-cleft, almost 2-lipped. May be treated as warmhouse species of Clerodendron.

186. Amaryllis Belladonna.

calycìna, Hook. f. (*A. punícea,* Hort. not Vahl. *Taligàlea punícea,* Hort.) Lvs. 6–12 in. long, elliptic, acuminate, coarsely irregularly toothed or sinuate, glabrous, except the floral ones: fls. 1½–2 in. long, drooping; calyx nearly 1 in. long, red. B.M. 6915. Gn. 27:130. R.B. 20:13.

A. erécta, Linn. A slender, sparingly branched shrub: lvs. alternate and whorled, 4–5 in. long, oblong, crenate-serrate, dark green above, paler beneath: fls. white, racemosely paniculate; bracts scarlet. Guiana.

N. Taylor.†

AMBRÒSIA (a classical name). *Compósitæ.* About fifteen species of weedy evil-smelling herbs, mostly American. The common ragweed is *A. artemisiæfolia,* Linn. The kingweed of western wheatfields, and also of low waste places, is *A. trifida,* Linn. Probably none is cultivated, the listed *Ambrosia mexicana* probably being of some other genus, very likely an artemisia.

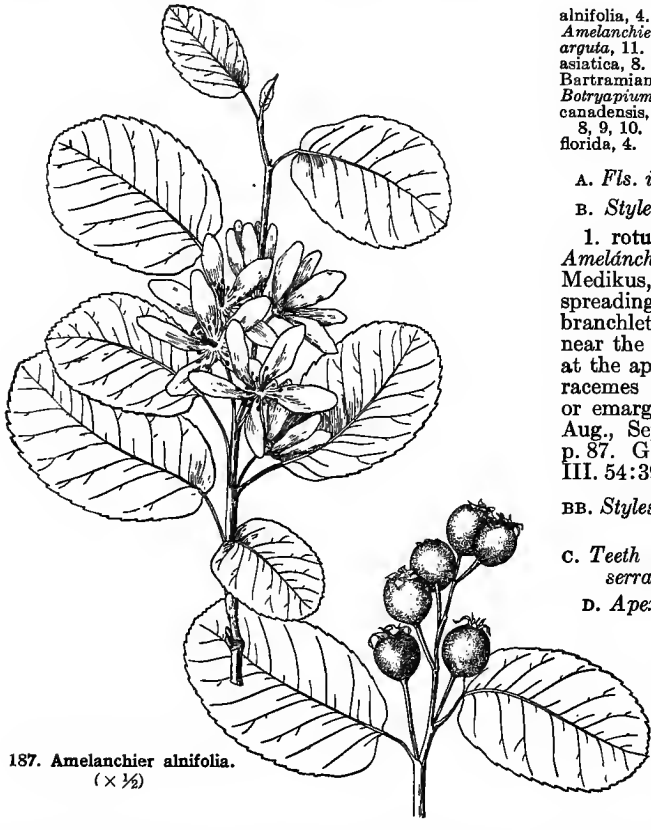
AMBROSÍNIA (Giacinti Ambrosini, an Italian). *Aràceæ.* A dwarf perennial tuberous herb of Italy and Algeria.

Spathe boat-shaped, lying on the earth, the mouth gaping; spadix included: fr. a many-seeded berry.—Half-hardy; planted in the open or in pots, and blooming in the fall. A single species.

Bássii, Linn. Three or 4 in.: lvs. 2 or 3, overtopping the spathe, the lf.-blade ovate or ovate-elliptic, obtuse, often retuse: spathe ¾in. long, tipped with a brown tail, divided lengthwise, the anthers being in one compartment (which has a hole to admit insects), and the solitary ovary in the other, thus preventing automatic close pollination. B.M. 6360.—There is a narrow-leaved form (var. **angustifôlia,** Guss.), a spotted-leaved form (var. **maculâta,** Engler), and a form with pale green reticulations (var. **reticulâta,** Engler). Propagation is by seeds started inside or in frames, or by division in spring. L. H. B.

AMELÁNCHIER (said to be a Savoy name). *Rosàceæ*. SHAD-BUSH. JUNEBERRY. Ornamental woody subjects chiefly cultivated for their profuse white flowers appearing in early spring; some species also grown for their fruits.

Deciduous shrubs or small trees: winter-buds conspicuous, pointed, with several imbricate scales: lvs. alternate, petioled, serrate: fls. in racemes terminal on short branchlets, rarely solitary; calyx-tube campanulate, adnate to the ovary, with 5 persistent lobes; petals 5; stamens 10–20; styles 2–5; ovary inferior, 2–5-celled, each cell with 2 ovules and subdivided: fr. a berry-like pome, juicy, with a cavity at the top.—About 20 or 25 species, most of them in N. Amer., 2 in Mex., 4 in Eu., and W. Asia, and 1 in E. Asia. The species are closely related and often difficult to distinguish,



187. Amelanchier alnifolia. (× ½)

especially as numerous spontaneous hybrids apparently occur. For a detailed treatment of the species of E. N. Amer., see Wiegand in Rhodora 14, p. 117 (1912). In trade catalogues, they are sometimes confused with Aronia, which is easily distinguished by its compound corymbose infl., 5-celled mealy fr. and by the midrib of the lvs. being glandular above.

The amelanchiers are deciduous shrubs or trees with simple, suborbicular to oblong serrate leaves, rather small white flowers in racemes followed by purplish or bluish black berry-like fruits. They are very desirable for ornament, producing a profusion of white flowers in early spring, and range from shrubs only a few feet high, as *A. humilis* and *A. stolonifera*, to trees attaining 40 feet in height, as *A. canadensis* and *A. lævis*. The latter species is perhaps the most beautiful, the white color of the pendulous loose racemes being enhanced by the red bracts and the bronzy red color of the unfolding leaves; the other species are pure white when blooming, the young leaves being covered by a whitish tomentum. *A. humilis* and *A. stolonifera* and also *A. sanguinea* seem to be the best for fruit, which ripens later than the others; there is also a large-fruited form of *A. lævis*. See *Juneberry*.

All the species mentioned below are hardy North and thrive upon a variety of soils and succeed well in dry climates; some, as *A. sanguinea*, *A. humilis* and *A. rotundifolia* show a preference for calcareous soil and grow well in dry situations, while others, as *A. oblongifolia* and *A. Bartramiana* prefer moist and swampy soil.

Propagation is by seeds sown soon after ripening or stratified and sown in spring and the stoloniferous species also by suckers; rare kinds are sometimes budded in summer on a common species or on Cratægus.

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A. *Fls. in racemes: lvs. folded in bud; petioles slender.*

B. *Styles free, very short, not exceeding the calyx-tube.*

1. **rotundifòlia,** Dum.-Cours., not Roem. (*A. Amelánchier*, Sarg. *A. vulgàris*, Moench. *A. ovàlis*, Medikus, not Borkh.). SERVICE-BERRY. Upright or spreading, rather stiff-branched shrub, 2–8 ft.: young branchlets tomentose: lvs. oval to obovate, serrate from near the base, subcordate at the base, usually rounded at the apex, 1–2 in. long, woolly beneath when young: racemes many-fld.; petals linear-oblanceolate, obtuse or emarginate: fr. bluish black, bloomy. May; fr. in Aug., Sept. Cent. and S. Eu. B.M. 2430. H.W. 3, p. 87. G.C. II. 9:793. M.D.G. 1900:497 (habit). J.H. III. 54:395.

BB. *Styles more or less connate at the base, about as long as the stamens.*

C. *Teeth of lvs. about 4–7 to ½in.; lvs. rather coarsely serrate; veins usually straight and close together.*

D. *Apex of lvs. acute or acutish; blade densely woolly beneath when young.*

2. **sanguínea,** DC. (*A. rotundifòlia*, Roem., not Dum.-Cours. *A. canadénsis* var. *spicàta*, Sarg., in part. *A. spicàta*, Rob. & Fernald, not Koch). Slender shrub: sts. solitary or few together, to 8 ft. high: lvs. orbicular-oval to oval-oblong, rounded or subcordate at the base, 1⅓–2⅓ in. long, serrate nearly to the base: fls. on a loose, usually nodding raceme; petals ½in. long; summit of ovary densely woolly: fr. rather large, nearly black, bloomy, juicy and sweet. Maine to Minn. and Ala. May; fr. in Aug., Sept. B.B. 2:238 (as *A. rotundifolia*).—Var. **grandiflòra** (forma *grandiflora*, Wiegand). Fls. large; petals ¾in. long and nearly ¼in. wide.

3. **hùmilis,** Wiegand (*A. spicàta* of many writers, not Koch). Stiffly upright shrub, 1–4 ft., stoloniferous and forming patches: lvs. oval-oblong or oval, subcordate or rarely rounded at the base, 1–2 in. long, serrate to below the middle: racemes many-fld., rather dense and upright; fls. small; petals oblong-obovate, about ⅛in. long: fr. nearly black, bloomy, juicy and sweet. May; fr. in Aug. Vt. to Alberta, south to N. Y. and Iowa.

DD. *Apex of lvs. rounded or truncate: blade very soon glabrous.*

4. **alnifòlia,** Nutt. (*A. canadénsis* var. *alnifòlia*, Torr. & Gray). Fig. 187. Shrub with rather stout upright branches, to 10 ft.: lvs. broadly oval to oval-truncate or subcordate at the base, 1–1¾ in. long,

coarsely and sharply toothed rarely below the middle, floccose-tomentose at first, very soon becoming glabrous: racemes many-fld., upright, short and dense, slightly tomentose at first; fls. rather small; petals oblong to narrowly oblong, ⅛–½in. long; sepals short: summit of the ovary woolly: fr. nearly black, bloomy. May; fr. in July. Mich. to Ore. and Wash. S.S. 4:196. S.F. 1:185; 5:415. G.M. 52:143 (habit). Var. **flòrida,** Schneid. (*A. flòrida,* Lindl. *A. oxýodon,* Koehne). Lvs. and racemes glabrous or nearly so from the beginning. B.R. 19:1589. Var. **pùmila,** Schneid. (*A. canadénsis* var. *pùmila,* Nutt.). Glabrous like the preceding var., but very low and stoloniferous.

CC. *Teeth of lvs. 7–15 to ½in.; lvs. finely and closely serrate.*

D. *Lvs. tomentose when young.*

E. *Apex of lvs. obtuse, rounded or sub-acute.*

F. *Top of ovary woolly: lvs. generally oval.*

5. **stolonífera,** Wiegand (*A. spicàta,* Brit. & Brown, in part, not Koch. *A. ovàlis* of many authors, not Medikus). Upright stoloniferous shrub, 1–4 ft. high, forming patches: lvs. oval, rarely oval-oblong or orbicular, rounded at the base or rarely subcordate, 1–2 in. long, finely serrate, usually quite or nearly entire on the lower third, glabrous above, densely white-tomentose beneath when young: racemes short, dense, upright, tomentose or nearly glabrous; fls. small; petals obovate-oblong, about ⅓in. long; top of ovary woolly: fr. purplish black, bloomy, juicy and sweet. May, a few days later than *A. lævis;* fr. in July. Newfoundland and Maine to Va.

6. **ovàlis,** Borkh. (*A. spicàta,* Koch, *Cratægus spicàta,* Lam.). Bushy shrub with numerous sts., to 12 ft.: lvs. oval to obovate, sometimes oval-oblong, 1½–2½ in. long, serrate to the base, white-tomentose beneath when young: racemes upright, woolly; petals obovate, ⅓in. long; top of ovary woolly: fr. bluish black, with the sepals upright and slightly spreading. M.D.G. 1900: 496.—This is possibly a hybrid between the preceding and the following species; much cult. in Eu.

FF. *Top of ovary glabrous or nearly so: lvs. generally oblong.*

7. **oblongifòlia,** Roem. (*A. canadénsis* var. *oblongifòlia,* Torr. & Gray. *A. Botryàpium,* Brit. & Brown, in part. *A. obovàlis,* Ashe.). Shrub, with slender upright sts. growing in rather dense clumps, but not stoloniferous, to 25 ft.: lvs. oblong to obovate-oblong, usually rounded at the base, and rounded or acute at the apex, 1¼–2½ in. long, very finely serrate nearly or quite to the base, white-tomentose beneath when young: racemes short, dense and upright, silky-tomentose; petals obovate-oblong to oblanceolate or linear, about ⅓in. long; top of ovary glabrous or sometimes slightly woolly; fr. nearly black, with bloom, sweet. May, with *A. lævis;* fr. in June. Maine to S. C.—S.S. 4:195. Em. 2:503 (lower figure). B.M. 7619. G.C. III. 21:333. D.G.M. 1900: 497 (habit).—This differs from all other species except *A. ovalis* and *A. Bartramiana* in having the sepals on the immature fr. upright or only slightly spreading; in the other species they are recurved.

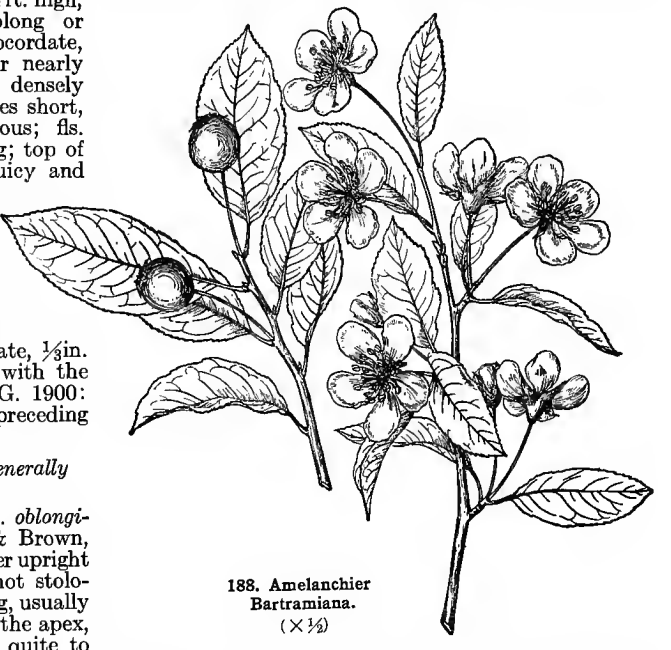
EE. *Apex of lvs. very acute or shortly acuminate.*

8. **asiàtica,** Endl. (*A. canadénsis* var. *asiática,* Miq. *A. japónica,* Hort.). Shrub or tree, to 40 ft., with slender spreading branches: lvs. ovate to oblong-elliptic, acute, rounded or subcordate at the base, 2–3 in. long, finely serrate all around, densely white or yellow tomentose beneath when young: racemes rather dense, nodding, woolly, top of ovary woolly: fr. bluish black. May; fr. in Sept. Japan, Korea. S.Z. 1:42. S.I.F. 1:47. Var. **sínica,** Schneid. Lvs. less tomentose, often finally glabrous, smaller, usually serrate only above the middle. China.

9. **canadénsis,** Medikus (*A. Botryàpium,* Borkh. *A. canadénsis* var. *Botryàpium,* Torr. & Gray. *A. canadénsis* var. *tomentúla,* Sarg.). SERVICE-BERRY. Bushy tree, fastigiately branched: st. solitary or few, sometimes shrubby: lvs. generally obovate, less often ovate, oval or oblong, acute or acuminate, usually cordate at the base, 1½–3½ in. long, sharply serrate quite or nearly to the base, densely white-tomentose beneath when young, less so above, tomentum usually partly persistent: racemes rather dense, nodding, silky-tomentose; petals linear or linear-oblong, about ½in. long; top of ovary glabrous or slightly hairy: fr. maroon-purple, tasteless. May, early, before the lvs.; fr. in June. Maine to Iowa, Mo. and south to Ga. and La. S.S. 4: 194. B.R. 14:1174. Gn. 73, p. 239 (habit; may be *A. oblongifolia*).—This is the only species with the lvs. tomentose on both surfaces when young.

DD. *Lvs. quite glabrous.*

10. **lævis,** Wiegand (*A. canadénsis,* Gray, not Medikus). Irregularly branched tree, with spreading branches, to 40 ft., sometimes shrubby: lvs. oval-ovate to ovate-oblong, short-acuminate, subcordate or rotundate at the base, rarely broadly cuneate, 1½–2½ in. long, sharply serrate nearly to the base, quite glabrous and purplish when young: racemes slender, many-fld., drooping, glabrous or nearly so, lower pedicels very long, in fl. about 1 in., in fr. sometimes 2 in. long; petals oblong-linear, about ½in. long; top of ovary glabrous: fr. purple or nearly black, bloomy, juicy and fairly sweet. May; fr. in June. From Newfoundland to Mich. and Kans., south to Ga. and Ala. Em. 2:503 (upper figures). H.T. 242. M.D.G. 1900:494, 495. G. 16:48; 34:343 (habit). G.M. 44:306 (habit).—This is the most graceful and the handsomest species in bloom, differing from all other species in the purplish young foliage and the drooping racemes.



188. Amelanchier Bartramiana. (×½)

AA. *Fls. solitary or 2 or 3 at the end of the branchlets; petals broad, obovate: lvs. imbricate in the bud, flat when unfolding; petioles short, less than ⅓in. long.*

11. **Bartramiàna,** Roem. (*A. oligocárpa,* Roem. *A. argùta,* Nutt.). Fig. 188. Shrub, to 8 ft.: lvs. elliptic

to elliptic-oblong, acute or rounded at the apex, cuneate at the base, 1¼–2 in. long, sharply serrate to below the middle or nearly to the base, glabrous when young: fls. 1–3, pedicels glabrous, ½–1 in. long; petals about ⅓in. long; top of ovary woolly: fr. purplish black, bloomy. May; fr. in July and Aug. Swamps. Labrador to Mich. and Minn., south in the mts. to Pa. G.F. 1:247 (adapted in Fig. 188).

A. Cùsickii, Fernald. Shrub, to 10 ft.: lvs. suborbicular, about 1½ in. long, glabrous or nearly so: fls. large, petals oblong, about ¾in. long: fr. scarlet, finally black. Ore. and Wash. to Idaho.—Not in cult., but ought to be intro., as it has the largest fls. of all.—*A. utahénsis*, Koehne. Dwarf shrub with small obovate lvs. scarcely 1 in. long, pubescent on both sides: racemes short, with very small fls. Utah and Ariz.—Not in cult.; the plant cult. under this name belongs to another species, to which could not be determined.

ALFRED REHDER.

AMÉLLUS (for the river Mella). *Compósitæ.* Nine or 10 Cape of Good Hope annual and perennial herbs allied to Aster. Lvs. hairy, oblong, opposite below: heads solitary and terminal or lateral; fls. blue-rayed; pappus single. **A. Lychnìtis**, Linn., sometimes grown as an evergreen glasshouse plant, has linear-lanceolate hoary lvs. and showy blue or violet fls. Summer bloomer, a few inches high.

AMHÉRSTIA (Countess Amherst and her daughter, Lady Amherst, promoters of botany in India). *Leguminòsæ.* A monotypic genus comprising **A. nóbilis**, Wall., one of the noblest of flowering trees, native to India, where it reaches a height of 40 ft. and more. Fls. gaudy red, 8 in. long, with wide-spreading petals, the upper ones gold-tipped, and colored petal-like bracts, in long, hanging racemes: lvs. pinnate, nearly 3 ft. long. The tree first flowered in Eng. in 1849. It requires hothouse treatment. The fls. last only 2 or 3 days. Demands rich, loamy soil, and abundant moisture during the growing season, after which the wood must be ripened firm. Propagation is by seeds, more often by cuttings of half-ripened wood under a glass, with bottom heat of about 80°. Thrives well in the open in Jamaica. B.M. 4453. F.S. 5:513–516.

N. TAYLOR.†

AMIANTHIUM: *Zygadenus.*

AMÍCIA (named for J. B. Amici, Italian physicist, born 1786). *Leguminòsæ.* Woody plants, one of which is known in cultivation as a half-hardy greenhouse subject, or in the open in warmer regions.

Straggling pellucid-dotted shrubs, or sub-shrubs, with alternate abruptly pinnate lvs. and few lfts.: fls. rather large, papilionaceous, yellow, in axillary or terminal racemes or rarely solitary; calyx with 2 very large upper segms. and very small lateral segms.; stamens equal: fr. very narrow, compressed, jointed.—About 5 species in the mts. of Mex. to Bolivia.

Zygomèris, DC. Eight feet, pubescent: lfts. 2 pairs, obcordate or wedge-shape, mucronate: fls. large, pale yellow with purple on the keel: pod 2-jointed. Mex. —Intro. in S. Calif.; unusual in greenhouses. L. H. B.

AMMÒBIUM (Greek, *living in sand*). *Compósitæ.* Hardy herb, cult. as an everlasting or immortelle.

Florets perfect, yellow, surrounded by a dry, silvery white involucre, and subtended by chaffy scales; pappus of 2 bristles and 2 teeth.—Two or 3 Australian species. Commonly grown as an annual, but seeds are sometimes sown in Sept., and the plant treated as a biennial. Of easiest culture, the seeds being sown where the plants are to grow. In the N., sow seeds in spring. Cut the fls. before they are fully expanded, and hang in a dry, shady place. They will then remain white.

alàtum, R. Br. Three ft. or less high, erect and branchy, white-cottony, the branches broadly winged: early root-lvs. ovate at the ends and long-tapering below (javelin-shaped); st.-lvs. small and distant, entire or nearly so: heads 1–2 in. across, the involucre becoming pearly white, petal-like; fls. all tubular. V. 2:62. Austral. A large-headed form is var. **grándiflòrum**, Hort.

L. H. B.

AMMÓCHARIS (*ammos*, sand; *charis*, beauty). *Amaryllidàceæ.* Greenhouse bulb, cultivated for late winter and spring bloom.

Allied to Brunsvigia, but the perianth regular, the tube cylindrical and straight, ovary flask-shaped and narrowed to a neck.—Two species in Cape of Good Hope region (by some regarded as forms of one species): *A. falcata*, Herb., with limb 4 times length of tube, and *A. coranica*, Burchell, B.R. 139:1219 (as Amaryllis), with limb only twice as long.

falcàta, Herb. Bulb ovoid, sometimes 6–9 in. diam., with brown tunics: lvs. 1–2 ft. long, 1 in. wide, strap-shaped, spreading, produced in spring before the bloom: fls. 20–40, in an umbel, bright red, fragrant.—*A. falcata* requires rich, loamy soil. It starts to grow in the spring. Give plenty of water during growing season in summer. It can be cult. out-of-doors. When perfected and finished in autumn, the bulb may be put under the greenhouse bench; keep moderately dry in sand or earth; may be potted in January, after which it will soon throw out its fine, fragrant blooms.

L. H. B.†

AMMONIACAL CARBONATE OF COPPER: *Fungicide.*

AMMÓPHILA (Greek, *ammos*, sand, and *philein*, to love). *Gramíneæ.* Perennial grasses, with long, creeping rootstalks and spike-like panicles: spikelets 1-fld., awnless, the rachilla prolonged behind the palea as a hairy bristle; lemma firm, about as long as the glumes, hairy at the base; palea as long as lemma — Species 1 or 2, on the sandy seacoast of Eu., the Atlantic Coast of N. Amer. and the shores of the Great Lakes.

arenària, Link (*A. arundinàcea*, Host). BEACH-GRASS. MARRAM-GRASS. SEA SAND-REED. PSAMMA. One to 3 ft.: blades long, somewhat involute: panicle pale, several in. or as much as a ft. long. Dept. Agric., Div. Agrost. 7:167; 14:11. Sand-dunes along the seacoast.—On account of the long, hard, branching rootstocks, it has been much used as a sand-binder in Eu. and certain parts of Amer., especially Cape Cod and Golden Gate Park in San Francisco.

A. S. HITCHCOCK.

AMÒMUM (Greek-made name, referring to the qualities as antidote for poisons). *Zingiberàceæ.* Hothouse ginger-like herbs with narrow entire leaves, grown for the habit and foliage and for the flowers in dense cone-like spikes.

Amomums are aromatic tropical and subtropical plants, spreading by means of hard rhizomes and forming dense masses of handsome erect or spreading annual sts. and linear, lanceolate or elliptic lvs.: fls. in dense cone-like spikes or racemes, half hidden in the floral-bracts; calyx funnel-shaped, split down one side, only slightly toothed; corolla-tube cylindrical, little longer than the calyx, the upper lobe curved, the 2 lower spreading and narrow; lip (staminode) large and petal-like, mostly obovate-cuneate; fertile stamen with a narrow or a very slender filament: fr. ovoid, with a thick and fleshy exterior.—About 50 species in tropics of Asia, Afr. and Pacific Isls., allied to Alpinia and Elettaria. The "grains of paradise" are amomum seeds, of several species, probably mostly of *A. Granum-Paradisii* and *A. Melegueta;* they are used, or have been used, for flavoring beverages. Cardamons (aromatic tonic seeds) are secured from species of Amomum and from Elettaria.

Some of the amomums are extremely handsome as foliage plants, apart from their flowers. Many of the species have been confused with and included with the genus Alpinia, but may be readily distinguished from the flower-clusters, being borne on erect-solitary peduncles arising from the base of the leafy stem or direct

from the rhizome, the inflorescence in Alpinia being always terminal on the leafy shoots. They thrive in an open soil, rich in humus and with abundance of water during the growing period. They require a rest of several months and to be kept on the dry side, but not so dry in the case of the evergreen species as to cause the leaves to shrivel.

Cárdamon, Linn. CARDAMON. Plant, 4–8 ft.: lvs. thick, spicy, lanceolate: fls. brownish, in a recumbent compound spike. E. Indies.—Produces many of the cardamon seeds of commerce. Not to be confounded with *Elettaria Caradamomum* (which see). Sometimes seen in growing collections of economic plants. Forms very large clumps.

Meleguèta, Roscoe. Plant 4–5 ft., the rhizome slender: lvs. lanceolate, acuminate, glabrous, 6–9 in. long and 1 in. or less broad, narrowed at base and nearly sessile on sheath: fls. solitary, 3–4 in. long, short-peduncled; upper corolla-lobe 2–3 in. long; lip 2 in. or less broad, pure white or tinged pink: caps. flask-shaped, 3 in. long, red or orange when ripe. Trop. Afr.

Gránum-Paradìsii, Linn. (*A. grandiflòrum,* Smith. *A. Afzèlii,* Roscoe). Plant 4–5 ft.: sts. red at base, rhizome slender: lvs. lanceolate, acuminate, glabrous, 4–8 in. long and 1¾ in. or less broad at middle, wedge-shaped at base and short-stalked on sheath: fls. 3–4 in the spike, the peduncles 2–6 in. long, white; corolla-lobes 2 in. long; lip 2 in. or less long, yellow at the throat: caps. ovoid, pubescent, 2–3 in. long, much grooved. Guinea. B.M. 4603.

angustifòlium, Sonn. (*A. madagascariénse,* Lam. *A. Daniéllii,* Hook. f. *A. Clùsii,* Hanb. *A. erythrocárpum,* Ridl.). Plant, 10–15 ft., the rhizome stout: lvs. oblong-lanceolate, acute, thin and glabrous, the lower ones 1 ft. or more long and 3 in. broad, nearly sessile: fls. several in spike, yellow, tinged red; upper corolla-lobe oblong, 1½ in. long; lip about as large as the lobe, deflexed. W. and E. Afr. B.M. 4764, 5250.

hemisphæ̀ricum, Baker. Sts. densely tufted, 10–12 ft.: lvs. distichous, short-petioled above the sheathing base, 1½ ft. long and 3 in. broad, cuspidate, green above and claret-brown beneath: fls. very numerous, in a globose head, the outer bracts large and empty, obtuse, tinged brown, the inner bracts nearly as long as the fl.; lobes of calyx and corolla green; lip strap-shaped, emarginate, red-brown in middle and yellow at edge. Straits Settlements. B.M. 7592.

magnìficum, Benth & Hook. f. A species of large dimensions, reaching, when planted out in a rich soil, up to a height of 20 ft.: rhizomes branching freely, stout, dark brown, green when young: lf.-st. erect, arching at top, terete: lvs. distichous shortly petiolate, lanceolate or elliptic, 1–2 ft. long, acute, glabrous, upper side green, (red when young) lower side suffused with reddish brown: peduncle stout, solitary, 2–5 ft. high; infl. a globose head with large bright scarlet and green bracts, outer bracts 3 in. long, ovate, or ovate-lanceolate; fls. numerous, densely crowded near the center of the head; sepals lanceolate, an inch long, primrose, tinted with red; petals lanceolate, slightly longer than the sepals, yellow, tinted with red; lip longer than the corolla-lobes, red, with a margin of yellow. Mauritius. B.M. 3192 (as Alpinia).

vitellìnum, Lindl. Stemless, glabrous, 2 ft.: lvs. oval: fls. in oblong loose sessile spike, yellow; lip oblong. E. Indies(?).

vittàtum, Bull, not Hance. A handsome dwarf evergreen species with each leading shoot bearing 2–4 erect or spreading elliptic lvs. 4–5 in. in length, alternately striped with silvery white and dark green on the upper side, and dull green on the lower. Habitat unknown. —Habit neat and compact, and similar in general appearance to some of the calatheas. Easily prop. by division of the rhizomes.

L. H. B.
C. P. RAFFILL.

AMÓRPHA (Greek *amorphos,* deformed; the fls. are destitute of wings and keel). *Leguminòsæ.* FALSE INDIGO. Ornamental plants grown for their foliage and flowers.

Shrubs, sometimes suffruticose: lvs. alternate, odd-pinnate, deciduous, with entire small lfts: fls. in dense terminal spikes, small, papilionaceous, but without wings and keel; calyx campanulate with 5 nearly equal teeth or the lower ones longer; standard folded around the stamens; stamens connate at the base, exserted: pod short, indehiscent, slightly curved, with 1–2 seeds. —Ten to 15 closely related species in N. Amer., south to Mex. Conspectus of all the known species by Schneider in Bot. Gaz. 43:297 (1907).

Amorphas are low or medium-sized shrubs with graceful pinnate foliage and small blue or purple flowers, in dense upright spikes.

Most of the species are hardy as far north as Massachusetts; farther north they must be considered as only half-hardy. They grow well in sunny and somewhat dry situations but *A. fruticosa* prefers moist soil; they are well adapted for the borders of shrubberies.

Propagation is usually by seeds; also by greenwood cuttings under glass in early summer, or by hardwood cuttings, placed in sheltered situations early in fall and left undisturbed till the following autumn. They may be grown, also, from layers and suckers.

189. Amorpha fruticosa. (×¼)

A. *Lowest pair of lfts. close to the st.: plant grayish or whitish pubescent, suffruticose.*

canéscens, Nutt. LEAD-PLANT. Low shrub, 1–3 ft., densely white-canescent: lvs. 2–4 in. long; lfts. 21–49, nearly sessile, oval or ovate-lanceolate, acutish, 4–7 lines long: fls. blue, the spikes crowded into terminal panicles: pod tomentose. June. Southern states. Mn. 5:707. B.M. 6618. R.H. 1896: 280.—Handsome free-flowering shrub of dense habit, well adapted for rockeries and borders of shrubberies in sunny and well-drained situations.

herbàcea, Walt. (*A. pubéscens,* Willd. *A. pùmila,* Michx.). Low shrub, 2–4 ft., grayish pubescent: lvs. 2–6 in. long; lfts. 11–37, elliptic to oblong, rounded at both ends, 4–6 lines long, pubescent or glabrous above, beneath dotted with dark glands, short-petioluled: fls. varying from violet-purple to white, spikes in terminal clusters: pod glandular. N.C. to Fla. L.B.C. 7:689.

AA. *Lowest pair of lfts. remote from the st.: plant glabrous or nearly so, rarely yellowish pubescent.*

B. *Calyx with the lower lobes elongated and pointed: pod curved on the back: young growth finely tomentose.*

fruticòsa, Linn. BASTARD INDIGO. Fig. 189. Shrub, 5–20 ft.: lvs. 6–10 in. long,: lfts. 11–21, oval or elliptic, ½–1½ in. long, mostly obtuse and mucronulate: spikes dense, 3–6 in. long, usually in panicles; fls. dark purple: pods stout, glandular. From Wis. and Pa. south. B.R. 5:427.—Interesting ornamental shrub of spreading habit, with fine feathery foliage; remarkable for the unusual color of its dark violet-purplish fls. A very

variable species; of the many varieties, the following are probably the most important: Var. **crôceo-lanâta,** Mouillef. (*A. cròceo-lanàta,* Wats.). Covered with yellowish brown pubescence. W.D.B. 2:139. Var. **albiflòra,** Sheldon. With white fls. Var. **cærùlea,** Mouillef. With pale blue fls. Var. **péndula,** Dipp. (*A. péndula,* Carr.). With recurved or pendulous branches. Var. **hûmilis,** Schneid. (*A. hùmilis,* Tausch). Low form with smaller and narrower lvs. B.M. 2112 (as *A. nana*). Var. **crîspa,** Kirchn. Lvs. with crisp margin.

tennessénsis, Shuttlw. Shrub, 5–20 ft.: lvs. 6–8 in. long; lfts. 13–55, elliptic-oblong to oblong-ovate, ¼–¾in. long, obtuse: spikes clustered, to 6 in. long; fls. violet-purple: pods slender, glandular. Tenn.

BB. *Calyx with all the lobes very shallow and rounded: pod straight on the back: young growth glabrous, bloomy and purplish.*

glâbra, Poir. (*A. montàna,* Boynt.). Glabrous shrub, to 6 ft. high: branches purplish: lvs. 3–6 in. long; lfts. 9–19, ovate or oval to oblong-ovate, 1–2 in. long, obtuse, rounded at the base: spikes clustered, 2½–6 in. long; fls. blue; calyx-lobes very short and obtuse: pods nearly straight on the back with few glands. Spring. N. C. to Ga. and Ala.

A. californica, Nutt. Allied to A. fruticosa. Only very young branches pubescent: lfts. 11–17, oval to elliptic-oblong, obtuse, broadly cuneate at the base: spikes 2–4, to 12 in. long. Calif.—*A. californica,* Hook. & Arn.=A. hispidula.—*A. caroliniàna,* Croom (A. glabra, Boynt., not Poir.). Allied to A. fruticosa. Lfts. numerous, elliptic-oblong, about ½in. long, glabrous: racemes several, 4–8 in. long: pods nearly straight on the back. Summer. N. C. to Fla. —*A. glàbra,* Boynt, not Poir.=A. caroliniana.—*A. hispìdula,* Greene (A. californica, Hook. & Arn., not Nutt.). Allied to A. fruticosa. Branchlets and petioles with prickly glands and pubescent: lfts. 17–25, ovate to oblong, villous: spikes solitary, to 7 in. long: pods very glandular. Calif.—*A. lævigàta,* Nutt. Allied to A. fruticosa. Glabrous: lfts. 9–21, remote, elliptic to elliptic-oblong, obtuse or emarginate, cuneate at the base, 1–1¾ in. long.: racemes solitary or several, to 12 in. long: pod straight on the back, very glandular. Spring. Ark., Texas. Var *pubéscens,* Gray (A. texana, Buckl.). More or less pubescent. Texas.—*A. microphýlla,* Pursh (A. nana, Nutt.). One ft. high: lfts. small, ½in. long, crowded, glandular beneath: spikes usually single. From Minn. and Iowa west to Rocky Mts.—*A. montàna,* Boynt.=A. glabra.—*A. nàna,* Nutt.=A. microphylla; see also A. fruticosa, var. humilis.—*A. paniculàta,* Torr. & Gray. Shrub, to 12 ft. high; grayish tomentose: lfts. 11–17, ovate-oblong or elliptic-oblong, 1–2 in. long: racemes long and slender, panicled. Texas.—*A. pubéscens,* Willd.=A. herbacea.—*A. pùmila,* Michx.=A. herbacea.—*A. texàna,* Buckl.=A. lævigata var. pubescens.—*A. virgàta,* Small. Allied to A. fruticosa. Perennial, 2–6 ft., sparingly branched: lfts. broad, coriaceous: spikes single or few. Southern states.

ALFRED REHDER.

AMORPHOPHÁLLUS (Greek-made name). *Aràceæ.* Giant aroids from the eastern tropics, grown as curiosities in hothouses.

Leaves ample; petioles smooth or warty and variously spotted; blade ample, 3-parted, the divisions pinnatifid: spadix long; spathe (or "flower") funnel- or bell-shaped at the base, springing from the great bulb-like tuber in advance of the lvs., the latter usually pedately compound: differs from Arum and related genera by technical characters. Monogr. by Engler in De Candolle's Monographiæ Phanerogamarum, Vol. 2, 1879.

Amorphophalluses are propagated by offsets of the tubers. These offsets are miniature tubers which grow out of the parent tuber. They are taken off at the time of potting, placed in pots just large enough to accommodate them, in a soil composed of loam, leaf-mold and sand in about equal proportions and kept in a temperature of 65° to 70°. They are rarely, if ever, propagated by seeds in northern gardens, and for this reason, together with their disagreeable odor when in flower, they are not commonly grown. The flowers are like a huge calla except that the spathe and spadix are of a dark chocolate color. The odor is supposed to attract carrion-loving insects, which pollinate the flowers in their native home and bring about the production of seeds. Towards the end of March the plants should be taken from their winter quarters and placed on the stages of a moderately warm greenhouse and kept moist, where, if the tubers are strong enough, they will soon flower. The leaves begin to grow immediately after the flowering season. Toward the end of May, they should be planted out in the open ground, or they may be used in subtropical bedding. Plants should be lifted in the fall, before frost, and potted in any good, rich soil, and placed in a warm greenhouse to ripen off the leaves, after which they may be stored away under the greenhouse stages, or in any convenient place where the temperature does not fall below 50°, giving just sufficient moisture to keep the tubers from shriveling. (E. J. Canning.)

190. Flower-stem and bit of leaf of Amorphophallus Rivieri.

Rivièri, Dur. DEVIL'S TONGUE. SNAKE PALM. Fig. 190. Scape (sent up in early spring) preceding the lvs., 3–4 ft., dark-colored and speckled with light red: lf. often 4 ft. across, pedately decompound, the petiole mottled, standing on a stalk like an umbrella: spathe rosy, calla-like, with a long-projecting and slender, dark red, slightly curved spadix, the whole "flower" often measuring 3 ft. long. Cochin China. R.H. 1871, p. 573. Gn. M. 5:232. G.W. 14, p. 173. V. 7:116.—The best-known species in American gardens. Has a strong and disagreeable odor.

campanulàtus, Blume. STANLEY'S WASH-TUB. Scape lower (2 ft. or less); spathe nearly or quite 2 ft. broad and 15 in. high, with a horizontal, spreading fluted border (not calla-like), red-purple on the margin and grayish, spotted white lower down, and becoming purple in the center; spadix 10–12 in. high, the purple top enlarged and convoluted: lf. much as in *A. Rivieri:* tuber weighing 8–10 lbs., shape of a flat cheese. An old garden plant from E. Indies. B.M. 2812 (as *Arum campanulatum*). F.S. 15:1602–3. G.C. 1872: 1720, 1721; III. 5:755. G.W. 13; p. 9.

gigantêus, Blanc. "Fl. larger than *A. campanulatus* (often 2 ft. across) and much more pleasing in color, shading from deep red to cream-color toward the center. The club-shaped spadix is dark maroon, with yellow and red base. After flowering, the foliage-st. appears,—a stout st. of deep green color, mottled with gray. After growing at the rate of several inches a day, it expands into a large palm-like lf., of a rich, dark green color, often measuring 5 ft. across." Blanc, 1892, received "under this name from India." *A. campanulatus*(?). Probably not the *A. giganteus* of Blume.

simlénse, Blanc. "Fl. 15 in. long, the inside of peculiar golden color, spotted purple; the back is metallic brown. Fine palm-like foliage." The cut in Blanc's catalogue shows a spathe produced into a long foliaceous summit, and a long, slender, recurved spadix. Probably of some other genus: perhaps Sauromatum.

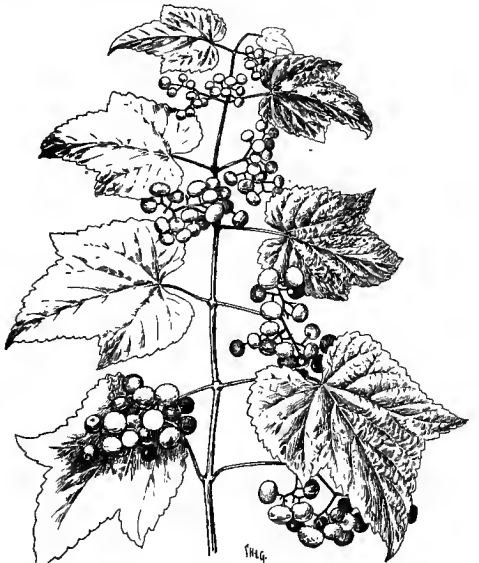
A. Afzèlii, Hort. (Corynophallus Afzelii, Schott)=Hydrosme leonensis.—*A. Eichleri,* Hook. f. Spathe 2 in. across, purple and white: spadix 5 or 6 in. high, thick, brown: lf. single, much divided. W. Afr. B.M. 7091.—*A. Elliòttii,* Hook. Spathe short and broad, dull pink with pale green spots: lvs. tripinnatifid, 18 in. broad. B.M. 7349.—*A. Lacòurii,* Linden. (Pseudodracontium Lacourii, N.E. Br.). Petioles barred with yellow; blades much cut, green, spotted white. Cochin China. I.H. 25:316.—*A. leonénsis,* Lem. Spathe 6 in. long, pear-shaped, the tube bell-shaped, white, dilated into the dark purple limb which is striped and spotted with white; lvs. about 1 ft. wide, tripinnatifid. B.M. 7768.—*A. Leopoldiànus,* Nichols. (Hydrosme Leopoldiana, Mast.). Spathe reddish, long acuminate on one side, with undulate margins; spadix 2–3 ft., terete,

recurved: lf. 2–3 ft. across. Congo. I.H. 34:23; 42, p. 380.—*A. nivòsus*, Lem., I.H 12:424 = Dracontium asperum.—*A. oncophýllus*, Prain. Spathe 6–7 in. long, the tuber broadly ovoid, white, striped and spotted, the limb brown-purple with yellow spots: lvs. tripinnatifid. Andaman Arch. B.M. 7327.—*A. Prùinii*, Hook. f. Tuber 6–10 in. diam., not bulbiferous: lvs. 3–5 ft. tall, the petiole green, mottled gray-white on red; spathe-tube 2 in. long, pale green spotted white, the limb 6–8 in. across, yellow, purple-brown inside at base. Perak.—*A. Rèx*, Prain. A larger plant than A. campanulatus, the tuber 1 ft. across: lvs. 5–6 ft. tall, the petiole purplish, marked gray and green: spathe campanulate, 12–18 in. across, pale red-purple; spadix with an appendage 10–14 in. long. Java.—*A. sativus*, Blume. Petiole 2–3 ft. tall, rugose, rough, white marked, each division of the blade pinnate-parted, the costa thick, white. Molucca Isls.—*A. Schweinfurthii*. N. E. Br. Spathe broad, reddish brown. E. Afr. —*A. Titànum*, Beccari. One of the most remarkable plants known. Tuber 5 ft. in circ.: lf.-stalk 10 ft.: lf.-blade 45 ft. in circ.: spathe 3 ft. in diam.; spadix 6 ft. high. Bloomed at Kew in 1890, the tuber dying thereafter. Sumatra. B.M. 7153–5. G.C. III. 5:748 (as conophallus).—*A. variàbilis*, Blume. Lvs. pinnatisect: spathe erect, 5 in. long, white inside, spotted outside, the margin rosy. Java and Philippines. G.C. II. 6: pp. 680, 681 (as Brachy-spatha). J.H. III. 33:493; 63: 283.—*A. viròsus*, N. E. Br. Spathe green externally, suffused with purple and spotted, internally lurid purple. Siam. B.M. 6978.

L. H. B.
GEORGE V. NASH.

AMPELÓPSIS (Greek *ampelos*, vine, and *opsis*, likeness). *Vitàceæ*. Ornamental woody vines with handsome deciduous foliage and some species with ornamental fruits, used for covering trellis-work, pergolas, arbors, low walls and the like.

Shrubs, climbing by tendrils: branches with close lenticillate bark and white pith and with tendrils opposite the lvs.: lvs. alternate, petioled, simple, lobed, digitate, pinnate or bipinnate: fls. small, greenish, perfect, in dichotomous long-peduncled cymes opposite the lvs. or terminal; calyx indistinct; petals 5, or rarely 4, expanding; stamens as many as petals, short; ovary 2-celled with a slender style, adnate to a distinct cup-shaped disk, entire or crenulate at the margin: fr. a 1–4-seeded berry.—About 20 species in N. Amer., Cent. and E. Asia. By some botanists united with Vitis, which is easily distinguished, even in the winter state, by its shredding bark and brown pith, also by the panicu-



191. Ampelopsis heterophylla var. amurensis. (×¼)

late infl. and the petals cohering into a cap and falling off as a whole; more closely related to Parthenocissus, which differs chiefly in its disk-bearing tendrils and the absence of a distinct disk in the fl.; still more closely to Cissus, which differs in the fleshy sts., usually 4-merous fls. and 4-lobed disk. Monogr. by Planchon in De Candolle, Monographiæ Phanerogamarum, 5:447–463.

The members of this genus are shrubs, climbing, with twining tendrils, not clinging by disks to its support, of medium height, with variously divided, rarely simple foliage, small greenish flowers, in peduncled cymes, followed by blue or yellow pea-sized berries. Most of the species are hardy North, but *A. japonica*, *A. megalophylla* and *A. arborea* are only half-hardy, while *A. cantoniensis* and *A. leeoides* can be grown only in warmer temperate regions. Page 3565.

They are not particular as to the soil and situation but grow best in fresh and loamy land. Where only a light covering is desired, species like *A. japonica*, *A. aconitifolia* and *A. arborea* should be planted; *A. heterophylla* var. *amurensis* makes a rather dense covering and is well suited for the covering of parapets, low walls and rocks; *A. megalophylla* is a very strong grower, with bold foliage. Some species, as *A. heterophylla* and particularly its var. *amurensis* are very ornamental in autumn with their bright blue profusely produced berries.

Propagation is by seeds and by hardwood or greenwood cuttings. All species may be propagated by cuttings with a good eye, placed in sandy soil under bell-glasses in September.

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A. *Lvs simple or lobed.*

B. *Under side of lvs. whitish: lvs. of firm texture.*

1. **humulifòlia**, Bunge. Lvs. broadly ovate, 3–5-lobed, sometimes only slightly so, 3–5 in. long, truncate or subcordate at the base, acute or acuminate, bright green and lustrous above, glaucescent and glabrous or hairy beneath: cymes slender peduncled: fr. few and small, usually pale yellow with bluish cheek, or pale yellow or entirely pale blue. N. China.—This species has been always confused with *A. heterophylla*, from which it is easily distinguished by the firmer texture of lvs., their pale whitish under side and the color of the frs. It is very hardy and the foliage has the appearance of that of a true Vitis.

2. **micans**, Rehd. (*Vitis rèpens*, Veitch, not Wight & Arn.). Shrub, climbing to 20 ft.: young growth purplish: branchlets glabrous: lvs. triangular-ovate and not lobed or broadly ovate and slightly 3-lobed, subcordate or sometimes truncate at the base, short-acuminate, the lobes acute, coarsely crenate-serrate, dark green and with a velvety sheen above, glaucescent below, 2–4 in. long: cymes long-stalked and rather dense: fr. dark blue. Cent. China.—Has proved hardy at the Arnold Arboretum. Var. **cinèrea**, Rehd. (*A. heterophýlla* var. *cinèrea*, Gagnep.). Lvs. grayish pubescent on both sides or only below, often deeply 3–5-lobed.

BB. *Under side of lvs. green: lvs. membranous.*

3. **cordàta**, Michx. (*Vitis indivìsa*, Willd. *Cissus Ampelópsis*, Pers.). Nearly glabrous: lvs. cordate, roundish-ovate, not or slightly 3-lobed, acuminate, acutely serrate, pale green beneath, usually pubescent on the veins: cymes loose, slender-stalked: berries bluish or greenish. From Ill. and Ohio south. Mn. N. 2:6.

4. **heterophýlla**, Sieb. & Zucc. (*Vitis heterophýlla*, Thunb.). Branchlets glabrous or hairy: lvs. cordate, 3–5-lobed, with rounded sinuses, sometimes slightly 3-lobed, lobes serrate or incised, shining green beneath and usually glabrous or sometimes hairy, 1½–3 in. long: cymes on stalks ½–2½ in. long: fr. changing from pale lilac to verdigris color and finally bright blue or

sometimes finally whitish. July, Aug.; fr. Sept., Oct. E. Asia. B.M. 5682 (as var. *humulifolia*). Gt. 1813: 765. Gn. 10, p. 451. Var. **élegans,** Koch (*A. tricolor,* Hort. *A. Sieböldii,* Hort. *Vitis heterophylla* var. *variegàta,* Nichols.). Lvs. smaller, blotched and striped with white; flushed pink when young; slow-growing and tenderer. Gn. 54, p. 5.—A handsomely colored form, adapted for planting in vases and baskets. Var. **citrulloïdes,** Schneid. (*A. citrulloïdes,* Lebas). Lvs. deeply lobed with rather narrow sinuately lobed segms. Var. **amurénsis,** Planch. (*A. brevipedunculàta,* Koehne. *Vitis brevipedunculàta,* Dipp.). Fig. 191. Branchlets and petioles usually hairy: lvs. slightly 3-lobed, 2–4 in. long, lobes crenately serrate, hairy beneath, at least on the veins: cymes rather dense: fr. darker blue.—The variety is a stronger grower than the type and strikingly beautiful in autumn with its variously colored berries; it is well adapted for covering low walls, rocks and trellises.

AA. *Lvs. 3–5-parted or digitate, at least partly, with usually lobed segms.*

B. *Segms. of the lvs. pinnately lobed or only serrate; the lower lvs. sometimes only lobed.*

5. **aconitifòlia,** Bunge (*A. dissécta,* Carr. *A. aconitifòlia* var. *dissécta,* Koehne. *A. affinis* var. *dissécta,* Hort.). Branchlets glabrous: lvs. 5-parted, the segms. pinnately lobed with rather narrow-toothed or entire lobes, 2–3 in. long, green beneath, glabrous or hairy on the veins: berries small, orange when fully ripe, sometimes bluish before ripening. Summer; fr. in autumn. N. China. R.H. 1868, p. 10; 1883, p. 318. Gn. 5, p. 523. G. 1:396.—Very handsome vine with finely divided foliage. Var. **palmìloba,** Rehd. (*A. palmìloba,* Carr. *A. tripartìta,* Carr. *A. rubricaùlis,* Schneid.). Lvs. usually 3-parted, the lower ones often only 3-lobed, segms. often rather broad, coarsely toothed, rarely pinnatifid. R.H. 1867, p. 10. J.H.S. 28:87 (form with rather narrow segms.).

6. **Delavayàna,** Planch. (*A. heterophýlla* var. *Delavayàna,* Gagnep. *Vitis Delavayàna,* Franch.). Young growth hairy and usually purplish: lvs. cordate at the base, partly 3-lobed and partly 3-parted, 2–5 in. long, segms. coarsely crenately toothed, dark green and nearly glabrous above, light green and pubescent beneath or sometimes glabrous, the middle segm. elliptic-oblong, cuneate, the lateral ones very unequal: cymes on peduncles 1 in. or less long: fr. dark blue or bluish black. Cent. China. J.H.S. 28:102.—A strong-growing vine, hardy.

BB. *Segms. of the lvs. pinnate; the pinnæ separate from the winged rachis.*

7. **japónica,** Makino (*A. serjaniæfòlia,* Bunge. *Vitis serjaniæfòlia,* Maxim. *A. napiformis,* Carr. *A. tuberòsa,* Carr.). Roots tuberous: plant glabrous: lvs. 3–5-parted or digitate, chartaceous, shining and dark green above, the divisions pinnate, with winged rachis, the pinnæ separate from the wings: berry small, blue, punctate. Japan, N. China. Gt. 16:531. R.H. 1870, p. 17. Gn. 6, p. 365. I.T. 5:176.—Very handsome vine with its lustrous and dark green, finely cut foliage, but somewhat tender.

AAA. *Lvs. bipinnate or pinnate; lfts. distinctly stalked.*

B. *Lfts. usually ½–1 in. long, very coarsely toothed.*

8. **arbòrea,** Koehne (*A. bipinnàta,* Michx. *Vitis bipinnàta,* Torr. & Gray. *Cissus stáns,* Pers.). PEPPER VINE. St. erect or somewhat climbing: lvs. bipinnate, 4–8 in long; pinnæ and lfts. on each segm. usually 5; lfts. broadly ovate or cuneate-obovate, coarsely toothed, ½–1½ in. long, veins beneath and rachis usually hairy: berries dark purple. Summer; fr. in autumn. Southern states, Mex. B.B. 2, p. 2409.—Handsome vine with bright green finely cut foliage; not hardy N.

BB. *Lfts. usually 2–4 in. long, crenate-serrate.*

9. **megalophýlla,** Diels & Gilg. (*Vitis megalóphýlla,* Veitch). Climbing to 30 ft., glabrous: lvs. long-petioled, 6–15 in. or sometimes longer, the larger ones bipinnate; the lower pinnæ with 3-9 lfts., the lowest pair often 3-lvd.; lfts. petioled, ovate or ovate-oblong, 2–5 in. long, rounded or subcordate at the base, membranous, remotely serrate, pale or glaucescent beneath, veins nearly straight, ending in the teeth: fr. bluish black, in loose cymes. W. China. J.H.S. 28:16, 86, 97. Gn. 65, p. 45.—Strong-growing vine, hardier and larger in every part than the following.

10. **cantoniénsis,** Planch. (*Vitis cantoniénsis,* Seem.). Lvs. long-petioled, similar to the preceding species but smaller; lfts. 1–3 in. long, cuneate or rounded at the base, sometimes nearly sessile, chartaceous, remotely and often indistinctly crenate-serrate, veins arching: fr. violet or pale violet. S. China to Malay. Penins.

A. Davidiàna, Mott.=Vitis Piasezkii.—*A. dumetòrum,* Hort.=Parthenocissus vitacea.—*A. Engelmánnii,* Hort.=Parthenocissus quinquefolia var. Engelmannii.—*A. Gràebneri,* Bolle=Parthenocissus quinquefolia var. hirsuta.—*A. hederàcea,* DC.=Parthenocissus quinquefolia.—*A. Henryàna,* Hort.=Parthenocissus Henryana.—*A. heptaphýlla,* Buckl.=Parthenocissus heptaphylla.—*A. himalayàna,* Royle=Parthenocissus himalayana.—*A. hirsùta,* Don =Parthenocissus quinquefolia var. hirsuta.—*A. Hóggii,* Hort.=Parthenocissus tricuspidata.—*A. incónstans,* Hort.=Parthenocissus tricuspidata.—*A. japónica,* Hort.=Parthenocissus tricuspidata.—*A. leeoïdes,* Planch. (Vitis leeoides, Maxim.). Allied to A. megalophylla. Lvs. usually pinnate, sometimes the lower lfts. 3-leaved; lfts. 5–7, ovate-oblong, 2–4½ in. long, rounded or broadly cuneate at the base, remotely serrate. S. Japan. Tender. J.H.S. 28:95, 96.—*A. Lòwii,* Hort.=Parthenocissus tricuspidata var. Lowii.—*A. macrophýlla,* Hort.=Parthenocissus vitacea var. macrophylla.—*A. muràlis,* Hort.=Parthenocissus quinquefolia var. murorum.— *A. orientàlis,* Planch. (Vitis orientalis, Boiss.). Allied and very similar to A. arborea: petioles longer; lvs. ovate-elliptic, quite glabrous: petals and stamens 4. Orient. G. C. 1871:1615.—*A. pubéscens,* Schlecht.=Parthenocissus quinquefolia var. hirsuta.—*A. quinquefòlia,* Michx.= Parthenocissus quinquefolia.— *A. radicantíssima,* Schelle= Parthenocissus quinquefolia var. murorum.—*A. radicantíssima,* Hort.=Parthenocissus quinquefolia var. hirsuta.—*A. Röylei,* Hort.=Parthenocissus quinquefolia var. murorum and P. tricuspidata.—*A. St. Paùlii,* Hort.=Parthenocissus quinquefolia var. St. Paulii.—*A. sempervirens,* Hort.=Cissus striata.—*A. Thómsonii,* Hort.=Parthenocissus Thomsonii.—*A. tricuspidàta* and *A. Veitchii,* Hort.=Parthenocissus tricuspidata.—*A. virginiàna,* Hort.=Parthenocissus quinquefolia.

ALFRED REHDER.

AMPELOPOVÌTIS: *Vitis.*

AMPHICARPÆA (Greek, alluding to the two kinds of pods). Spelled also *Amphicarpa. Leguminòsæ.* HOG PEANUT. A genus of 6–8 species of herbaceous perennial vines of E. N. Amer. and India, considered by some to contain also the species now credited to Falcata. Fls. of 2 kinds, the upper axillary, racemose and showy, the lower apetalous, fertile, and borne in the lower axils.—Not in the American trade and cult. only in botanic gardens. The only common species are *A. monoïca,* Ell. (*Falcàta comòsa,* Auct.), and *A. Pitcheri,* Torr. & Gray. Both are pubescent or glabrate vines, with trifoliolate lvs., white or purplish fls., and rather conspicuous pods.—Of little value horticulturally.

N. TAYLOR.

AMPHÍCOME (*amphi,* both, and *kome,* hair; the seeds having a tuft of hair at both ends). *Bignoniàceæ.* Greenhouse herbaceous rockery plants from the Himalayas, with large, rosy, funnel-shaped, 5-lobed fls. which are axillary or terminal: lvs. alternate, unequally pinnate.—Species 2.

argùta, Royle. Height 3 ft.: lvs. radical, the lfts. in 3–4 pairs, sessile, lanceolate, acuminate, deeply serrate: fls. in terminal racemes, fewer than in the next; corolla-tube rose-colored, trumpet-shaped; calyx-lobes long, awl-shaped. P.M. 6:79.—Intro. by Montarioso Nurseries.

A. Emòdi, Royle. Height 1½–3 ft.: lfts. in 5–7 pairs, cordate-ovate, obtuse, shortly petiolulate, margin crenate-lobate: fls. at first corymbose; corolla-tube and throat orange; calyx-lobes short, thick, fleshy. B.M. 4890. Gn. 8, p. 25; 38, p. 458. F.S. 11; 1109.

N. TAYLOR.†

AMPHIRÀPHIS: *Microglossa.*

AMSÒNIA, (named for Charles Amson, colonial physician in eighteenth century). Called also *Ansonia*. *Apocynàceæ*. Plants sold for border planting, mostly among shrubbery, but little known in cultivation.

Tough-barked perennial herbs with alternate narrow fvs. and terminal panicles of blue or bluish narrow-limbed small fls. in May and June, the inside of the corolla-tube bearing reflexed hairs and also the 5 stamens: fr. two long and slender many-seeded follicles.—About a dozen species in E. U. S. and E. Asia. Prop. mostly by dividing the clumps; also by seeds, and by cuttings in summer.

Tabernæmontàna, Walt. (*A. salicifòlia*, Pursh. *A. Amsònia*, Brit. *Tabernæmontàna Amsònia*, Linn.). Glabrous or nearly so, 2–3 ft.: lvs. willow-like, ovate to lanceolate, acuminate, alternate, short-petioled: fls. many, with lanceolate spreading lobes, succeeded by slender, milkweed-like follicles or pods 2–3 in. long. Holds its foliage late. Pa. to Fla. and Texas. B.M. 1873. L.B.C. 6:592. B.R. 151 (as *A. latifolia*).

angustifòlia, Michx. Villous when young, the st. 1–3 ft.: lvs. linear to lance-linear, an inch or two long, much crowded, margins becoming revolute: corolla-lobes ovate-oblong to linear-oblong. Dryland, N. C., to Texas. L. H. B.

AMYGDALÓPSIS: *Prunus*.

AMÝGDALUS (Greek-made name, referring to the furrowed pit). *Rosàceæ*. A name given to the peaches, apricots and their kin, but here treated as a section of the genus *Prunus*, which see.

ÁMYRIS (etymologically allied to *myrrh*, in allusion to the odor). *Rutàceæ*. TORCH-WOOD. Some 10 species of shrubs and trees ranging from the S. U. S. to Cent. Amer. and W. Indies, a few of which have been mentioned as evergreen cult. plants in hothouses. Lvs. alternate, compound but lfts. sometimes reduced to 1 as in some other rutaceous plants: fls. white, in axillary or terminal spikes; sepals and petals 4; stamens 8: fr. an ovoid or globose drupe, with a single stone.—Apparently none of the species is in cult. in this country, although *A. balsamífera*, Linn., of S. Fla. and the W. Indies, *A. Plumièri*, DC., of the W. Indies, and *A. braziliénsis* (properly *Pròtium braziliénse*, of the Burseraceæ) may occur.

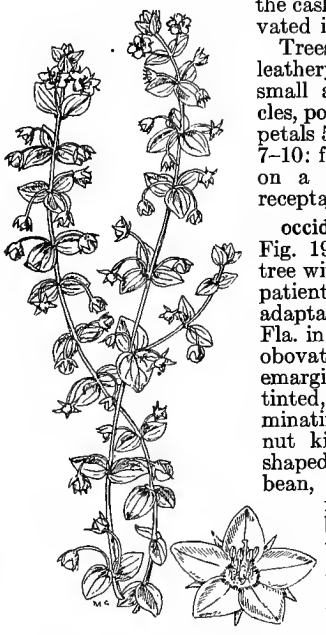
ANACÁMPSEROS (Greek-made name, of no significance here). *Portulacàceæ*. LOVE-PLANT. Succulent herbs, of a dozen species, from the Cape of Good Hope, but not grown in this country except in botanic gardens. They are greenhouse plants, with ovate fleshy lvs.: fls. racemose, expanding in the sun; petals 5, fugacious; sepals 5, oblong. Prop. by seeds or by cuttings of sts. or lvs. The commonest species is *A. arachnoìdes*, Sims, a peculiar, cobwebbed, green-lvd. succulent, with simple racemes of white fls. B.M. 1368.

192. Anacardium occidentale. (×⅛)

A. Bórderi, Hort., "is a Pyrenean alpine plant of easy culture in border or rockery; purple fls.; late-blooming." The name is apparently unknown in botanical literature.

N. TAYLOR.†

ANACÁRDIUM (name refers to the heart-shaped character of the nut). *Anacardiàceæ*. Eight species native to the American tropics, of which one (yielding the cashew nut) is widely cultivated in tropical countries.



193. Anagallis arvensis. (×¼)

Trees and shrubs with leathery alternate lvs.: fls. small and numerous in panicles, polygamous; calyx 5-cleft; petals 5, very narrow; stamens 7–10: fr. kidney-shaped, borne on a greatly enlarged hard receptacle.

occidentàle, Linn. CASHEW. Fig. 192. A large, spreading tree with milky juice, very impatient of frost, and therefore adaptable only to extreme S. Fla. in the U. S.: lvs. oval or obovate, rounded, or even emarginate at the top: fls. rosy-tinted, fragrant, in clusters terminating the young branches: nut kidney-shaped or heart-shaped, the size of a large bean, the kernel edible. This nut (about 1 in. long) is borne on a fleshy receptacle (the cashew apple, Fig. 33) which is about 3 in. high when mature, white to yellow and red, and is sweetish-sour and edible. Gn. 11, p. 211.—A vinous liquor is made from the apple. The kernel of the nut yields oil, and is edible when roasted; the shell of the nut is exceedingly acrid, even the fumes from the roasting being highly irritant. The tree yields a gum which is the basis of a varnish, being used to protect books and woodwork from the ravages of white ants and other insects. The tree grows 20–40 ft. high. Sometimes grown under glass in collections of economic plants; prop. then by cuttings of mature wood with lvs. retained. L. H. B.

ANAGÁLLIS (Greek, *delighting*). *Primulàceæ*. PIMPERNEL. Low annual, biennial or perennial herbs cultivated in the open for their numerous bright-colored blossoms.

Stems mostly angular, bearing opposite alternate or 3-whorled entire lvs.: fls. axillary, mostly solitary, usually not longer than the lvs., in shades of red, blue or white, the corolla rotate or rotate-bell-shaped and with lobes obovate or linear which are either entire or toothed; stamens 5, attached in the base of the corolla, the filaments usually bearded: fr. a globose caps., circumscissile.—Two dozen species of interesting little plants mostly with trailing or procumbent sts., in many parts of the world. Pax and Knuth, Engler's Pflanzenreich, hft. 22:321–334.

The pimpernels are of simple culture. They thrive in a warm soil, the seeds of the annual species being planted where the plants are to grow. The perennial kinds are increased by division, or by cuttings of young growths started under glass. All of them are free-flowering and attractive minor plants. The many forms in gardens are probably all referable to two species.

A. *Lvs. ovate.*

arvénsis, Linn. (*A. pulchélla*, Salisb. *A. orientàlis*, Hort. *A. Monéllii*, Bieb., not Linn.). COMMON PIMPERNEL, or POOR MAN'S WEATHERGLASS (fls. close at approach of bad weather). Fig. 193. Annual: sts. procumbent or ascending, the branches becoming long, slightly winged: lvs. opposite or in 3's, sessile: fls. scarlet varying to white, the lobes broadly obovate and

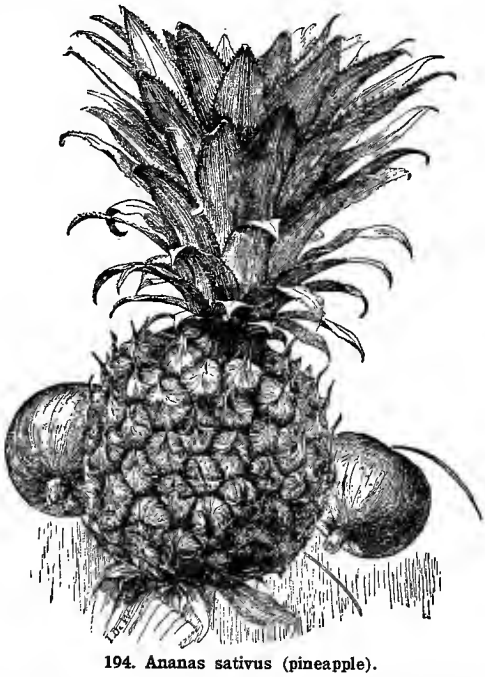
obtuse and the edges finely toothed. Eu., Asia, and sparingly run wild in N. Amer. Var. **phœnícea**, Gren. & Godr. Fls. red; corolla-lobes mostly glandular-ciliate at top. Var. **cærùlea**, Gren. & Godr. (*A. cærùlea*, Schreb. *A. verticillàta*, All.). Fls. blue; lobes not glandular and slightly ciliate. Var. **latifòlia**, Lange (*A. latifòlia*, Linn.). Fls. blue: lvs. very broad: plant stout. B.M. 2389.

AA. *Lvs. linear or linear-lanceolate (except perhaps in var. Monellii).*

linifòlia, Linn. (*A. angustifòlia*, Salisb. *A. fruticòsa*, Vent. *A. grandiflòra*, Andr. *A. Philipsii*, Hort.). Perennial or biennial: sts. woody at base, 1–1½ ft.: lvs. opposite or verticillate, sessile, acute, margin often revolute: fls. blue, reddish underneath, the lobes obovate, obtuse and entire. W. Medit. region. B. M. 831. Var. **Monéllii**, Knuth (*A. Monéllii*, Linn., not Bieb. *A. Willmoreàna*, Don). Lvs. often in 3's, somewhat broader (even to ovate or oblong): corolla longer. Var. **collìna**, Ball (*A. collìna*, Schousb.). Large, sts. thick: fls. rose-colored or purplish (not blue). Var. **microphýlla**, Ball. Many-std., branches ascending: lvs. small, lanceolate: fls. blue, reddish beneath.

L. H. B.

ANÀNAS (modified from aboriginal S. Amer. name). Written also *Ananassa*. *Bromeliàceæ*. Stove herbs, allied to the billbergias, and demanding the same general treatment. As ornamental subjects, grown mostly for the rosette of rigid lvs. and the strange, often colored head of fleshy fls., which are 6-cleft, with 6 stamens and 1 style. The ripe head is composed of the thickened rachis, in which the fleshy berry is imbedded, and the fleshy persistent bracts; in the pineapple, the fls. are abortive. Prop. by the leafy crown or topknot, by



194. Ananas sativus (pineapple).

strong suckers, or by small offsets from the base: these are treated as cuttings, being rooted in sand with bottom heat, or in the S. set directly in the field. Monogr. by Mez, DC., Monogr. Phaner. 9.

satìvus, Schult. f. PINEAPPLE, which see for field culture Fig. 194. Plant producing a single shaft 2–4 ft. high, and when 12–20 mos. old bearing a head, or pineapple, on the top of which is a rosette of stiff lvs.: lvs. long and sword-shaped, stiff, more or less rough-edged. The same stalk does not bear a second time, but a new shoot may arise from the same root and bear fruit. Better results are usually secured by severing the sucker or crown, and growing a new plant. American

195. Ananas sativus var. variegatus. (×⅙)

tropics. B.M. 1554 (as *Bromelia Ananas*). B.R. 1081 (as *A. bracteata*).—There is a common cult. form (var. *variegàtus* or *stratifòlius*), Fig. 195, with striped lvs. Gn. 51, p. 57. *A. Porteànus*, Koch, is a form of *A. sativus*, with olive-green, sharp-spined lvs. with a yellow central band. G.W. 5, p. 51. *A. cochin-chinénsis*, Hort., is another form (intro. by Pitcher & Manda, 1891).

A. bracteàtus, Schult. f., is a showy species with red heads, all the bracts being elongated, spiny and prominent. Brazil. B.M. 5025. Regarded by Mez as a form of A. sativus.—*A. macrodóntes*, Morr., like a bromelia, has large toothed bracts. Brazil. —*A. Mordilònus*, Hort., a form of A. sativus probably, has variegated spineless lvs.

L. H. B.

ANÁPHALIS (Greek name of a similar plant). *Compósitæ*. EVERLASTING. Hardy border plant; useful for immortelles. A genus of 30 species, much like Antennaria, but differs in the pappus-bristles of the staminate fls. not being thickened (these are thickened upwards in that genus) and the st. leafy.

margaritàcea, Benth. & Hook. A foot or two high, with many corymbose heads, white: lvs. sessile, linear-lanceolate, long-pointed: involucre pearly white, hence the value of the plant as an everlasting. N. Amer. and Asia.—The plant from Asia, with yellow fls., is perhaps better referred to *A. cinnamòmea*, Clarke, but is hardly separable from the type. It is offered as a yellow everlasting.

N. TAYLOR.†

ANARRHÌNUM (*snoutless*). *Scrophulariàceæ*. A dozen biennials and perennials of S. Eu. and N. Afr. Allied to Antirrhinum, but not cult. in this country, except in botanic gardens. Fls. small, in interrupted spike-like racemes, white or blue. Easily grown in ordinary garden soil, but not certainly hardy north of New York. Known also as *Simbulata*.

ANASTÁTICA: *Resurrection Plant.*

ANCHÙSA (*anchousa*, a paint for the skin). *Boragindàceæ*. ALKANET. Hardy annual, biennial or perennial plants, with blue or purple fls. in panicled scorpioid racemes or sometimes in headlike clusters; the corolla trumpet-shaped and the throat closed by scales: lvs. alternate, usually hairy.—Of easy cult. in sunny position except *A. italica* var. "Dropmore," which is best suited in partial shade. Prop. by seed generally, but old perennials may be root-divided in spring.

A. *Fls. small, like forget-me-nots.*

Barrelièri, Vilm. Perennial: height 2 ft.: lvs. ovate-lanceolate, smaller and shorter than in *A. italica:* fls.

blue, with a white tube and pink or yellow throat. May. Eu. and Asia Minor. B.M. 2349.—Valued for its earliness and for cut-fls. The least common of the 3 species.

officinàlis, Linn. Biennial or perennial, 1–2 ft.: lvs. lanceolate, hairy, radical ones clustered: fls. opening in pairs, bright blue or purple, in loose, one-sided spikes. June–Oct. Eu.—Effective in masses and of easy cult. The common alkanet.

capénsis, Thunb. Biennial: height 1½ ft.: lvs. narrowly lanceolate and less hispid than in *A. italica:* fls. red-margined, with a white throat; buds red; calyx inflated after the fl. has withered; divisions short-obtuse. June–Sept. Cape of Good Hope. B.M. 1822.—Fine for cut-fls. Often winterkilled, but seeds itself freely; north of Boston best treated as a coolhouse plant. **Var. álba,** Hort., has white fls.

AA. *Fls. large.*

itálica, Retz. Perennial: height 3–5 ft.: lvs. largest of the 3 species here contrasted, ovate-lanceolate, rough, shining; radical ones sometimes 2 ft. long: fls. bright blue. Medit. B.M. 2197. L.B.C. 14:1383.—If not allowed to go to seed, will bloom continuously from June to Sept. Commonest and perhaps best species. **Var. Drópmore.** Fig. 196. Three ft.: fls. purple, in loose heads. Best suited to partial shade. Var. **supérba,** Hort., has very dark blue fls.

A. Agárdhii, Lehm. Lvs. linear. Siberia. Rare.—*A. myosotidiflòra,* Lehm. Lvs. large; radical ones long-petiolate, cordate-reniform; cauline ones sessile, oval. Siberia, Caucasus.—*A. ochroleùca,* Bieb. Perennial: 2 ft.: fls. yellowish white: lvs. minutely strigose, lanceolate, ciliate. July, Aug.—*A. sempérvirens,* Linn. Lvs. broadly ovate; lower ones petiolate: racemes short, generally bracted at the base. Eu. Esteemed in France. N. Taylor.†

ÁNDA: *Joannesià.*

ÁNDIRA (Brazilian name). *Leguminòsæ.* Angeleen Tree. Hothouse trees.

Trees, with conspicuous fls. in racemes: calyx 5-toothed or entire; keel petals distinct; ovary stalked: fr. a roundish 1-seeded pod.—Nearly 30 species of Tropical American and African.

Two or three species are sometimes cultivated in hothouses in the Old World and in American botanic gardens. They must be grown in rich loam and peat in the warmhouse. Propagation is by cuttings of ripened wood in sand under bell-jar, with bottom heat.

inérmis, HBK. Cabbage Tree. A tree 20–35 ft.: lvs. impari-pinnate, with 13–15 ovate-lanceolate and acute lfts.: fls. in terminal panicles, purple, on short pedicels. W. Indies and Brazil. N. Taylor.

ANDRÁCHNE (ancient Greek name). *Euphorbiàceæ.* Low shrubs with bright green foliage, of little ornamental value; sometimes grown in botanical collections.

Shrubs or perennials: lvs. alternate, usually entire: fls. small, monœcious or incompletely dicœcious, axillary, 5–6-merous; staminate in clusters, with petals smaller than the sepals, stamens with free filaments, not exceeding the sepals; pistillate usually solitary, with very small petals, sometimes wanting, ovary 3-celled with 3 distinct, 2-cleft or 2-parted styles: fr. a subglobose or depressed caps., separating into 3 2-valved carpels, 6-seeded.—Ten or 12 species in N. Amer., Peru, Asia, N. and S. Afr., Malay Archipelago.

These are low deciduous shrubs similar to Securinega, but smaller, with small bright green leaves, slender-stalked whitish inconspicuous flowers in axillary clusters or solitary, appearing during the summer followed by small greenish brown capsular fruits. There are three species in cultivation, of which two, *A. phyllanthoides* and *A. colchica,* have proved hardy at the Arnold Arboretum; they may be used in borders of shrubberies. They seem to grow in any soil, if it is well-drained, and prefer sunny positions.

Propagation is by seeds, which are usually freely produced, and also by greenwood cuttings under glass. None of the species is in the trade.

A. cólchica, Fisch. & Mey. Shrub, to 2 ft., usually lower, glaucescent, glabrous: lvs. ovate, obtuse, ⅛–½in. long: petals 5, filiform, as long as the glands of the disk, much shorter than the calyx: caps. depressed-globose, 1/6in. thick. Asia Minor.—*A. cordifòlia,* Muell. Arg. Shrub, to 3 ft.: lvs. ovate to oblong, rarely cordate at base, obtuse, 1–2 in. long, soft pubescent beneath: petals spathulate, disk-glands membranous: caps. depressed-globose, ¼in. thick. E. India.—*A. fruticòsa,* Linn. A greenhouse shrub from S. China with ovate or broadly ovate, short-stalked lvs., 1–1¾ in. long, and small greenish white, short-stalked fls., staminate as well as pistillate in axillary clusters of 3–6, is now referred to Breynia as B. fruticosa, Benth. It is probably no longer in cult. B.M. 1862 and L.B.C. 8: 731 (as Phyllanthus turbinata).—*A. phyllanthoides,* Muell. Arg. (A. Roemeriana, Muell. Arg.). Shrub, to 3 ft. with slender glabrous branches: lvs. oval to obovate, obtuse, ¼–1 in. long, glabrous or slightly pubescent beneath: petals little shorter than the sepals, obovate, dentate near the apex; disk-glands thick: caps. depressed-globose, about ⅛in. thick. Mo. to Ark. and Texas.

Alfred Rehder.

ANDROCÝMBIUM (name referring to arrangement of stamens around a cavity). *Liliàceæ.* A dozen or more species of bulbous plants growing from the

196. Anchusa italica, Dropmore variety. (×⅙)

Medit. region to S. Afr., one or two of which may be expected in choice greenhouse collections. Bulbs tunicated: sts. subterranean, from which arise a few narrow lvs.: fls. few, in short spikes and subtended by showy bracts in spring or summer. **A. melanthoides,** Willd., of S. and Cent. Afr., recently intro., has bulb like minute tulip: lvs. 2–4, from 3–9 in. long: fls. small, borne in clusters in axils of large bracts which reach 3 in. long and some of which are white, green-veined. G.C. III. 45:315, desc. **A. leucánthum,** Willd. (*A. punctàtum,* Baker, in part), of S. Afr., has few whitish fls. in dense umbel and 4 spreading lvs.

ANDRÓMEDA (Greek mythological name). *Ericàceæ.* Ornamental low plants grown for their evergreen foliage and for their flowers.

Evergreen shrubs: lvs. short-petioled, narrow, entire: fls. in terminal umbels, pedicelled; calyx small, 5-toothed; corolla urceolate with 5 short recurved lobes; stamens 10 with aristate anthers opening with pores: caps. dehiscent into 5 valves; seeds numerous, small. —Two species through the northern hemisphere.

The andromedas are low evergreen shrubs with small and narrow foliage and small pinkish flowers in terminal umbels. They are perfectly hardy North and suited for borders of evergreen shrubberies and for rockeries and grow best in peaty or sandy and moist soil and in half-shady positions.

Propagation is by seeds, sown thinly soon after maturity, in pots or pans of sandy peat soil, placed in a cool frame. They germinate easily if sown in cut sphagnum, but must be pricked into boxes as soon as they can be handled. Cuttings from mature wood, placed in sand under glass in fall, and kept in a cool greenhouse during the winter, will root easily; also increased by layers. See, also, *Leucothoë, Chamædaphne, Pieris* and *Zenobia.*

polifòlia, Linn. (*A. rosmarinifòlia,* Pursh). Fig. 197. One-half to 2 ft.: branchlets usually not glaucous: lvs. narrow-oblong to linear, ¾–1½ in. long, whitish-glaucous beneath, but not tomentose, later sometimes green, revolute at the margin: fls. nodding on slender pedicels, 2–4 times as long as the globose-urceolate corolla: caps. brownish, ob-ovoid or subglobose, as high as broad. June. N. Eu., N. Asia, rare in the colder regions of N. Amer. L. B. C. 18: 1714. G.W. 12, p. 50 (habit).—Varies with narrower and broader lvs. On account of its slender-stalked fls., more graceful than the following species.

197. Andromeda polifolia. (×¾)

glaucophýlla, Link. Similar to the preceding, but young branchlets glaucous: lvs. white beneath, with a fine tomentum: fls. on curved thick pedicels, rarely twice as long as the urceolate corolla: caps. depressed, glaucous. June. N. E. Amer., south to Minn. and Pa. L.B.C. 6:546; 16:1591; 18:1725.—Varies like the preceding species with broader and narrower lvs.

A. acuminàta, Ait.=Leucothoë populifolia.—*A. arbòrea,* Linn. =Oxydendrum arboreum.—*A. axillàris,* Michx.=Leucothoë Catesbæi.—*A. axillàris,* Lam.=L. axillaris.—*A. calyculàta,* Linn.=Chamædaphne calyculata.—*A. campanulàta,* Miq.=Enkianthus campanulatus.—*A. cándida,* Hort.=Zenobia pulverulenta.—*A. cassiniæfòlia,* Vent.=Z. pulverulenta.—*A. Càtesbæi,* Walt.=Leucothoë Catesbæi.—*A. cérnua,* Miq.=Enkianthus cernuus.—*A. dealbàta,* Lindl.=Zenobia pulverulenta.—*A. fastigiàta,* Wall.=Cassiope fastigiata.—*A. ferrugínea,* Walt.=Lyonia ferruginea.—*A. floribúnda,* Pursh=Pieris floribunda.—*A. formòsa,* Walt.=Pieris formosa.—*A. glaùca,* Hort.=Zenobia pulverulenta.—*A. japónica,* Thunb.= Pieris japonica.—*A. ligustrìna,* Mubl.=Lyonia ligustrina.—*A. mariàna,* Linn.=Pieris mariana.—*A. nítida,* Bartr.=Pieris nitida. —*A. ovalifòlia,* Wall.=Pieris ovalifolia.—*A. paniculàta,* Ait.= Lyonia ligustrina.—*A. parabólica,* Duham.=L. ligustrina.—*A. populifòlia,* Lam.=Leucothoë populifolia.—*A. pulverulénta,* Bartr.= Zenobia pulverulenta.—*A. racemòsa,* Linn.=Leucothoë racemosa. —*A. speciòsa,* Michx.=Zenobia pulverulenta.—*A. tetrágona,* Linn. =Cassiope tetragona.—*A. tomentòsa,* Hort., not Dum.-Cours.= Lyonia ligustrina pubescens.

ALFRED REHDER.

ANDROPÒGON (Greek, *aner,* man, and *pogon,* beard, referring to the silky hairs on the spikelets of some species). *Gramíneæ.* BEARD-GRASS. Annual or mostly perennial grasses of various habit but usually with coarse foliage, scarcely horticultural.

Spikelets in pairs at each joint of an articulate rachis, one sessile, perfect, 1-fld.; the other pedicelled, staminate, neutral or reduced to a pedicel; glumes of fertile spikelet equal, indurated, the first dorsally compressed, the second keeled; sterile and fertile lemmas hyaline, the latter usually awned; palea minute or wanting: rachis usually hairy, often conspicuously so.—A large genus of probably 200 species, widely distributed in both hemispheres except in the colder regions. Includes several important native forage grasses such as blue-stem or blue-joint (*A. furcatus,* Muhl.) with about 3 digitate spikes at the summit of the tall culm; and little blue-stem (*A. scoparius,* Michx.), with single spikes scattered along the branches, both species of the prairie region. Broom sedge (*A. virginicus,* Linn.), a common grass of the Atlantic states, is considered troublesome, though it has some forage value before it flowers. Some of the species, such as silver beard-grass (*A. argenteus,* DC.), are ornamental on account of the silvery panicles. This is a stout grass, 2–4 ft., with bearded nodes and long-stalked oval panicles consisting of numerous woolly ascending or appressed spikes.

Several species of oil-producing grasses formerly included in Andropogon are now referred to other genera. *A. Nárdus,* Linn.=Cymbopogon Nardus, Rendle. *A. citràtus,* DC.=Cymbopogon citratus, DC. *A. Schoenánthus,* Linn.=Cymbopogon Schoenanthus, Spreng. *A. squarròsus,* Linn.=Vetiveria zizanioides, Nash.

For a discussion of the sorghums and Johnson-grass referred by some authors to Andropogon, see *Holcus;* also Vol. II, Cyclo. Amer. Agric. A. S. HITCHCOCK.

ANDRÓSACE (old Greek name of no significance here). *Primulàceæ.* ROCK JASMINE. Small tufted plants grown in the alpine garden.

Root-lvs. clustered: scapes mostly not exceeding 8 in. high, often very short: fls. mostly pink, red and purplish, sometimes white, primula-like but constricted at the throat, umbellate or solitary, in early spring.—Over 80 species in Eu., Asia, N. Amer. and Pacific Isls. Pax and Knuth, Engler's Pflanzenreich, hft. 22:172–220.

Many species of rock jasmine are known in European gardens, and they are much prized by fanciers in alpine-gardening. The tufted leaves sit close to the rocks. Some of them are woolly-leaved. Only currently catalogued species are included in the present account. A well-drained soil, partial shade, free circulation of air, frequent waterings in dry summer months, and protection from heavy fall and spring rains, will lead to success with these charming alpines. A heavy shading of evergreen boughs in winter will be found of great benefit. Close covering is not to be recommended, because it smothers the plants. Very many species have been tried in this country, with variable and not very encouraging results, but in a few instances, with extra care, plants have done well. The northern aspect of a steep rockery seems to be the most favorable position for them. Propagation is by division, seeds or cuttings. Plants should be kept in pots until thoroughly established. The species are biennial or perennial except in group AAA below. Many of them are densely cespitose.

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A. *Lvs. long-petioled, large, orbicular-reniform or cordate, lobed or crenate.*

1. **Hénryi,** Oliver. Scape 3–9 in., woolly, 12–25-fld.: lvs. to 2½ in. across, orbicular-reniform, lobed and toothed: fls. white. China.

AA. *Lvs. sessile or nearly so, spatulate or linear, nearly or completely entire.*

B. *Fls. in umbels or umbellate heads.*

C. *Plant stout: scape 4 in. or more high.*

D. *Foliage woolly or villous.*

2. **lanuginòsa,** Wall. Whole plant densely white-villous: sts. leafy: lvs. small, ¾in. or less long, lance-ovate, acute: scapes axillary, about 4 in.; fls. rose-colored, in a dense umbel. Himalaya. B.M. 4005.

3. **sarmentòsa,** Wall. Creeping by brownish stolons: lvs. clustered, all basal, more or less woolly, lanceolate or ovate-lanceolate, acute, 1½ in. or less long: scapes often 4 in. long; fls. many, rose-colored. Himalaya. Var. **Chúmbyi,** Hort. (*A. chumyiénse,* Hort.). Rosettes dense, and the plant very cespitose: lvs. densely woolly.

DD. *Foliage bristly.*

E. *The lvs. not in rosettes, crowded at base of st., narrowed into petiole.*

4. **foliòsa,** Duby (*A. sarmentòsa* var. *foliòsa,* Hook. f.). Stolons thick, brownish, naked: lvs. all basal, obovate or ovate, sessile but base attenuated, mucronate or acute, ciliate, 1½ in. or less long: scape pilose, much exceeding lvs.; fls. flesh-colored becoming whitish. Himalaya. B.M. 6661.

EE. *The lvs. in rosettes, long-petioled, usually cordate.*

5. **spinulífera,** Knuth. Not stoloniferous, densely hairy: lvs. linear-obovate, 3 in. or less long with petiole, spinulose at apex: scape 10 in. or less; fls. numerous, densely capitate, purple. China.

6. **Aizòon,** Franch. Lvs. 1 in. or less, rosulate and imbricated, leathery and glaucous, spatulate, not spinulose: scape 1 ft. or less, many times exceeding the lvs., the bracts glandular; fls. 6–10, flesh-colored or red. Himalaya. Var. **coccínea,** Franch. (*A. Bulleyàna,* Hort.). Not glandular: fls. red or intense scarlet.

CC. *Plant slender: scape seldom 4 in. high: lvs. all rosulate (in rosettes).*

D. *The lvs. with hairy margins.*

7. **villòsa,** Linn. (*A. odoratíssima,* Schreb.). Entire plant densely white-hairy, loosely cespitose: lvs. linear-lanceolate or lance-ovate, sessile, entire: scape 2 in. or less; fls. white or rose with yellow-red throat, corolla equaling the calyx-lobes, the corolla-lobes obovate, entire or slightly emarginate. Eurasia. Very variable. Var. **arachnoídea,** Knuth (*A. arachnoídea,* Schott). More cespitose: lvs. oblong-ovate, densely webby-white: scape very short. Var. **robústa,** Knuth. Plant robust: lvs. lance-ovate, often densely congested, white-silky. Var. **Jacquemóntii,** Knuth (*A. Jacquemóntii,* Duby). Lvs. crowded, imbricated, ovate, obtuse, the hairs white to brown: scape long; fls. flesh-colored, the corolla-lobes obtuse and entire.

DD. *The lvs. glabrous, or only obscurely ciliate.*

8. **hedræántha,** Griseb. Cespitose: lvs. ½in. or less long, lance-oblong, obtuse, leathery, not crowded at base of st: scape very short (about 1 in.); fls. 5–10 in each umbel or head, violet-red or pale purple, the corolla-lobes obovate. Balkans.

9. **cárnea,** Linn. (*A. Reverchònii,* Jord. *A.ròsea,* Jord. & Fourr.). More or less densely cespitose: lvs. linear or subulate, ¾in. or less long: scape 3 in. or less; fls. 3–7, rose-colored or whitish, the throat yellow. Eurasia. L.B.C. I:40. Var. **Hálleri,** Linn. Lvs. twice longer than in type, recurved at apex, shining green, sparsely hairy. Var. **Lággeri,** Knuth (*A. Lággeri,* Huet.). Lvs. acuminate, spreading, deep green: scape very short: densely cespitose. Gn. 63, p. 333. Var. **brigantíaca,** Knuth (*A. brigantíaca,* Jord. & Fourr.). Lvs. narrowly linear, short, slightly denticulate at apex: scape to 5 in.: little cespitose.

10. **láctea,** Linn. (*A. pauciflòra,* Vill.). Cespitose, glabrous or nearly so: lvs. rosulate, membranous, linear or linear-lanceolate, obtusish, sparsely ciliate, 1 in. or less long: scape 5 in. or less; fls. snow-white. Eurasia. B.M. 868, 981. Var. **exímia,** Hook. Lvs. less rigid, strongly recurved: fls. larger (½in. across). Switz. B.M. 5906 (as *A. carnea* var. *eximia*).

BB. *Fls. solitary.*

11. **imbricàta,** Lam. Cespitose, stellate-pubescent: lvs. ¼in. long, linear-spatulate and obtuse, in densely superimposed imbricated rosettes. Alps.

AAA. *Lvs. scarcely petioled, oblong or linear, entire or dentate: fls. umbellate: annual.*

12. **lactiflòra,** Pall. (*A. angustifòlia,* Andr. *A. coronopifòlia,* Andr.). Glabrous, 1 ft. or less high: lvs. 2 in. or less long, rosulate, linear-lanceolate or linear-spatulate, acute, toothed: fls. milk-white, large. Asia.—A handsome little annual, often self-seeding.

A. Vitaliàna, Lapeyr., listed as the only yellow-fld. Androsace, is Douglasia Vitaliana. It is often catalogued as Aretia Vitaliana.

L. H. B.

ANDRÓSÆMUM: *Hypericum.*

ANDROSTÈPHIUM (Greek-made name, referring to the corona). *Liliàceæ.* BABIES' BREATH. Outdoor bulbous plants, allied to the brodieas.

Small genus of S. W. and Cent. U. S., with funnel-shaped, spreading-limbed, 6-lobed perianth, 6 stamens, and 3-angled ovary, and a corona or crown at the mouth: lvs. linear, radical: scape simple, leafless.—Plant in a sunny place in sandy soil, placing the bulbs 4–6 in. deep; protect in winter. Prop. by division of the bulbs and by seeds. The name "babies' breath" or "baby's breath" is commonly applied to Gypsophila.

violàceum, Torr. (*A. cærùleum,* Greene). Slender, 6–10 in.: umbel 2–7-fld., the fls. blue, 1 in. long, supported on a stout (¾in.) pedicel; crown exceeding the anthers.—Blooms in spring; pretty. N. TAYLOR.†

ANEILÈMA (Greek, *no involucre*). Syn., *Aphylax. Commelinàceæ.* Sixty tropical perennials, allied to Commelina, from which it may be distinguished by its sub-paniculate infl. *A. biflòrum,* R. Br., and *A. sínicum,* Lindl., are sometimes cult. in Old World hothouses and in American botanic gardens. These species are blue-fld., diffuse or trailing plants with their fls. having no involucral bracts. Culture as in Dichorisandra.

N. TAYLOR.†

ANÈMIA (Greek, *naked;* without indusia). *Schizæàceæ.* Tropical ferns, with 1–3 pinnate lvs. with the lower pair of pinnæ erect, elongate and bearing the sporangia in panicles at their extremities.—Of the 40 species, 2 are found in the southern states, and a few are occasionally in cult.

Anemias are dwarf, compact ferns, suited for shelves, or for growing near the glass in warm pits or low houses. They prefer being grown in small pots to being planted out in the fernery. Their growth is too slow to make them popular decorative ferns for general purposes. Propagation is by spores, which germinate freely; tufted kinds by division between March 15 and April 30.—Schneider, Book of Choice Ferns.

A. *Lf. 2–3-pinnate, with narrow divisions.*

adiantifòlia, Swartz. Lf.-blade 6–9 in. long on a stalk often twice as long, the ultimate divisions oblong or linear-cuneate, with the outer margin toothed. S. Fla. and tropics.

AA. *Lf. only once pinnate with broad pinnæ.*

B. *Veins free.*

mexicàna, Klotzsch. Lf.-blade 6–9 in. long, with 4–6 pinnæ on either side, which are distinctly stalked, ovate-lanceolate and rounded on both sides at the base: fertile pinnæ 3–4 in. long, dense. Texas and Mex.

collìna, Raddi. Lvs. 1 ft. high, stalks hairy, blades with about 10 lfts. on each side, which are rounded at the outer ends and truncate at the base: fertile pinnæ about 1½ in. long, dense. Brazil. S. 1:384.

198. Anemone patens var. Nuttaliana. (×⅓)

BB. *Veins anastomosing (netted).*

Phyllítidis, Swartz (*A. lanceolàta,* Lodd. *A. longifòlia,* Link. *Anemidictyon Phyllítidis,* Willd.). Lf.-blade 4–12 in. long, with 4–12 pairs of sessile pinnæ, with a crenulate margin and a rounded or unequal base; veins forming long, narrow areolæ: fertile pinnæ 3–9 in. long, dense. Cuba and Mex. to Brazil. S. 1:390.

L. M. UNDERWOOD.
R. C. BENEDICT.†

ANEMIDÍCTYON: *Anemia.*

ANEMÒNE (Greek, *wind*). *Ranunculàceæ.* ANEMONE, or ANEMONY. WINDFLOWER. Hardy and attractive flower-garden and border plants.

Stems usually erect, with great variation in height: basal lvs. lobed, divided or dissected, those of the st. forming an involucre near to, or remote from, the fl.: sepals few or many, petal-like; no true petals; stamens many, shorter than sepals: carpels numerous: fr. a 1-seeded achene.—A genus of about 85 species, with many handsome garden forms; all hardy perennials; cult. for their beautiful show of fls. and in a few cases for their striking foliage. Chiefly native of the north temperate and mountainous regions. As a technical generic name, pronounced anemòne; as a vernacular, anémone. Pritzel, Revision of Anemone, in Linnæa 15:498 (1841). Britton, N. Amer. Anemone, in Ann. N. Y. Acad. Sci. 6:217 (1891–92).

The plants thrive best in a fresh, rather rich, sandy loam, well drained; but most of the species will do well in any good garden soil. The tuberous-rooted species are suitable for hardy borders, while most of the others prefer a place in a rockery, and some are partial to shady places. *A. hortensis, A. coronaria, A. fulgens* and others will well repay the little indoor or greenhouse care they require for producing winter blossoms. They require essentially the same handling as tulips and hyacinths, and are usually classed with bulbous plants. Tubers placed in pots in September or October bring forth a beautiful show of bloom by January or March. For this purpose they should be well drained, and not kept very wet or too warm before the growth is well started; they prefer more moisture at flowering time. There are many garden varieties of anemone, among which are Whirlwind and Geante Blanche (white); Queen Charlotte, Lorely, and Kriemhilde (pink); Rosa Zwey (lavender-pink); Brilliant Diademe, Purpurine and Prinz Heinrich (carmine and magenta).

Nearly all the species can be readily propagated by both root-division and seed. The seeds are sown very shallow in a clean bed, in either warm fall or early spring. The division of roots is best made in early spring before growth starts. The season for both outdoor and indoor planting will directly influence the flowering season. Good months for outdoor planting are September, October, November, December, February and March. As a rule, the tuberous anemones will blossom at any time desired, being influenced by the time they are kept out of the ground. The bulbs may be ripened after flowering time by being taken from the ground to dry, or by covering the bed to keep out rains. *A. japonica* is one of the finest of all fall-blooming herbs.

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A. *Achenes with long styles, which may become feather-like on ripening; fls. solitary.—Pulsatilla section.*

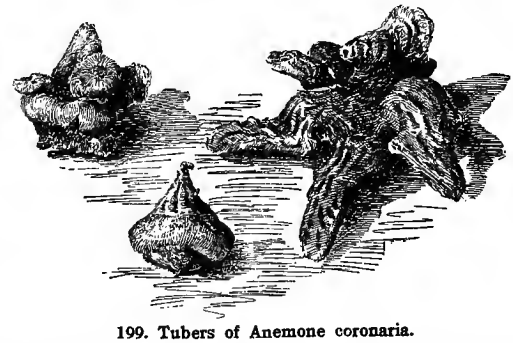
B. *Involucre bell-shaped, dissected into numerous linear equal lobes.*

1. **vernàlis,** Linn. (*Pulsatílla vernàlis,* Mill. *A. sulphùrea,* All.). Very shaggy, 6 in. high or less: lvs. pinnately parted, segms. trifid: fls. purple without, whitish within, and smoothish; erect, on very short peduncles; sepals 6, rarely spreading. Apr. Cool, moist places. Eu. J.H. III. 32:223. Gn. 25:320. Gn. W. 20:891; 26:134. F.E. 18:320. G. 20:158.

2. **Hálleri,** All. Villous, 6 in. or less in height; simple: lvs. pinnately divided with segms. 3–4-parted; the lesser divisions lanceolate-linear; involucre of long narrow segms., sessile: fls. large, erect, whitish purple; sepals 6; anthers yellow. Apr. Sunny places. Switzerland. L.B.C. 10:940.

3. **pàtens,** Linn. Much like the first variety below, which is more common in Amer., but differs in its broader and shorter lf.-segms. and smaller fls. Eu. Gn. 60, p. 364; 65, p. 167.

Var. **Nuttalliàna,** Gray (*Pulsatílla hirsutíssima,* Brit.). WILD PATENS. AMERICAN PASQUE FLOWER. Fig. 198. Villous, with long, silky hairs, 4–9 in. high: radical lvs. petioled, others sessile, all much divided into narrow, linear, acute lobes: fls. appearing before



199. Tubers of Anemone coronaria.

the root-lvs., bluish purple or whitish, erect, seldom nodding: achenes silky: styles plumose, becoming 2 in. long; peduncle elongates several in. after flowering. Apr. Low ground. North central states and Siberia. C.L.A. 3:177. Gn. M. 13:15.

Var. **ochroleùca,** Sims. Fls. creamy white, appearing at same time as basal lvs. March, Apr. J.H. III. 30:343. B.M. 1994.

4. **Pulsatílla,** Linn. (*Pulsatílla vulgàris,* Mill. *A. acutipétala,* Schleich). Pasque Flower of Europe. Villous, hairy, rising ¾–1 ft.: basal lvs. finely thrice-pinnately divided, on slender petioles; involucre sessile, deeply cut into long narrow lobes: fls. blue to reddish purple, 1½–2½ in. across. Apr. Well-drained soil or stony places. Eu. Gn. 32:466; 71, p. 215, 530. L.B.C. 18:1704. G.C. III. 39:307. Gn. M. 13:17. G.M. 52:636. Gn.W. 20:225. Var **rùbra,** Hort. (*A. rùbra,* Lam.). Dwarfer: fls. always erect. Var. **variegàta,** Hort. Fls. pale, appearing in May.

BB. *Involucre lvs. 3, on short petioles, sheathing the st.*

5. **occidentàlis,** Wats. (*A. alpìna,* Hook., not Linn.). Silky-hairy, ½–1½ ft. high, simple: lvs. 2-parted, the divisions deeply pinnatifid into usually incised linear, acute lobes; involucre short-petioled; basal lvs. long-petioled: fls. solitary, white or purple, varying, 1–2 in. across; receptacle conic, sometimes much elongated: achenes pubescent: plumose styles reflexed; peduncle becoming much elongated after sepals fall. May. Calif. to Brit. Col. Intro. 1892.

200. Anemone coronaria, single-flowered form. (× ⅓)

6. **alpìna,** Linn. (*A. acutipétala,* Hort.). Closely allied to the above. St. ¾–1½ ft. high, from thick, strong roots: lvs. large, finely divided, cut and serrated, smooth or hairy; lvs. of involucre similar: fls. few, in an umbel or solitary, 2–3 in. diam., creamy white inside, purple outside, but varying much; anthers yellow. Mountain-sides. Eu. May, June. L.B.C. 17:1617. B.M. 2007 (var. *major*). Var. **sulphùrea,** Hort. Fls. a delicate sulfur-yellow, larger, downy beneath: lvs. larger. Moist, rich soil. Gn. 35:10; 66, p. 195. G.M. 49:797.

AA. *Achenes woolly or smoothish, with short styles. (Anemone proper.)*

B. *Peduncle 1 (rarely 2): involucre mostly 3-lvd.*

C. *Head of fr. cylindric: achenes woolly.*

D. *Roots tuberous: involucre usually sessile.*

7. **coronària,** Linn. Poppy-flowered Anemone. Figs. 199, 200, 201, 202. One-half to 1 ft. high, from tuberous roots: lvs. cut into many fine lobes and lobules; involucral lvs. sessile, 3–4-parted, deeply cut: fls. 1½–2½ in. across, poppy-like, of many colors and mixtures of red, blue, white, etc.; stamens blue. Early in spring to June. Meadows, Medit. region. V. 11:257. B.M. 841. Gn. 50:6; 61, p. 275; 16, p. 111. A.F. 25:93. C.L.A. 4:344. G. 24:5. G.L. 20:355. Gn.M. 13:296 J.H. III. 48:383. R.H. 1893:232.—Caen, Scarlet, The Bride, St. Brigid, Victoria Giant, etc., are some of the trade names given to the single forms. Var. **flòre-plèno,** Hort. Fls. double, as shown in Fig. 202; many colors, scarlet being the most common at present. F.S. 16:1678. Gn. 63, p. 353. Var. **chrysanthemiflòra,** Hort. A seedling variety produced in 1848, and intro. many years later. Fls. more completely doubled than the above variety by the stamens all becoming petal-like.—A dozen forms, beautiful, self-colored, as deep red, sky-blue and even pure white, have been fixed and named. Useful as cut-fl. Gn. 30:316. R.H. 1887:36; 1897, pp. 418–9. R.B 21:260–1.

201. Anemone coronaria, semi-double-flowered form. (× ¼)

8. **fúlgens,** Gay (*A. Pavoniàna* var. *fúlgens,* DC. *A. hortènsis,* Thore). Fig. 203. One ft. high, simple: basal lvs. 3–5-lobed, with rounded outline, followed later by deeply cut lvs.; involucre sessile, several in. below the solitary fl.: fls. vivid scarlet, 2 in. across; stamens black. May, June. France.—Sometimes called a variety of *A. hortensis,* Linn., from which it may have descended. Several garden forms, as *A. annuàta-grandiflòra, A. multipétala,* and Southern Star. Gn. 11:214. Gt. 37:66. R.B. 21:262–3. R.H. 1877:270. G. 4:91.

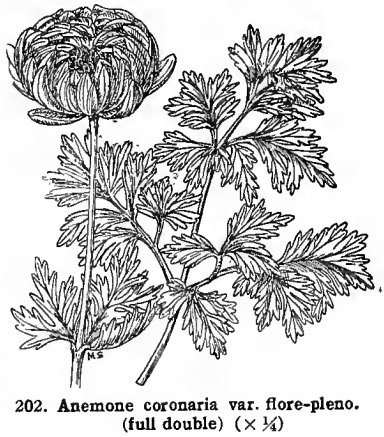
9. **horténsis,** Linn. (*A. stellàta,* Lam.). Broad-leaved Garden Anemone. Fig. 204. St. simple, erect, 10 in. high: basal lvs. lobed and cut irregularly; involucre small, 3–5-lobed, usually 3 or more in. below the fl.: fls. red, rosy purple, or whitish, single, 1½ in. across; stamens brownish violet. Rich, light soil. S. Eu. May.—This differs from *A. coronaria* in its coarse, broad lvs. and its elongated, rather narrow-pointed sepals. Garden names are given to the forms with different coloration. B.M. 123. Gn. 61, p. 352. F.W. 1877:257.

10. **palmàta,** Linn. St. 6–9 in. high from tuberous root: basal lvs. leathery, 3–5-lobed, cordate, toothed; involucral lvs. 3-parted: fls. golden yellow, solitary or in 2's; sepals 10 or more. May, June. Deep, light soil. Medit. region. B.R. 200.—Three good varieties in the trade. Var. **flòre-plèno,** Hort., with double yellow or white fls. Var. **álbida,** Sims (var. *álba,* Hort.). Fls. white: basal lvs. lobed. B.M. 2079. L.B.C. 2:175. Gn. 22:466. Var. **lùtea,** Lodd. Like the last, but with yellow fls. L.B.C. 17:1660.

11. **caroliniàna,** Walt. (*A. decapétala,* Amer. authors, not Ard.). St. simple, slender, ½–1 ft. high, arising from a large tuber: lvs. of involucre sessile, with 3 wedge-shaped clefts; basal lvs. thrice divided, and much lobed and parted, slender-petioled: solitary fl. erect, 1–1½ in. broad, creamy white or purple; sepals often numerous: achenes densely woolly. April, May. Open places, U. S. G. 6:521.

DD. *Rootstock creeping: lvs. of involucre petioled.*

12. **sylvéstris,** Linn. St. 1–1½ ft., simple, or branched once at involucre, from a creeping rootstock: lvs. 3–4-parted, deeply cut at top, hairy beneath; involucre petioled: fls. solitary or in 2's, pure white, 1½ in. across, nodding, sweet-scented; sepals 6. May–July. Wooded places, Eu. and Liberia. B.M. 54. Gn. 18, p. 561; 30, p. 173; 65, p. 73; 75, p. 189. G. 2:223; 33:31.



202. Anemone coronaria var. flore-pleno. (full double) (× ¼)

Gn.M. 13:295. J.H. III. 57:80. L.B.C. 18:1739. Var. **flòre-plèno,** Hort. DOUBLE SNOWDROP ANEMONE. Has large, white, double fls. G.C. III. 19:739. *A. baicalénsis,* Turcz., is much like this species.

203. Anemone fulgens. (×¼)

204. Anemone hortensis. Reduced from an old cut, to show a little improved form.

CC. *Head of fr. hemispherical: achenes silky-pubescent.*

D. *Roots tuberous.*

13. **apennìna,** Linn. St. simple, slender, 4–9 in.: lvs. twice-divided and lobed, much toothed: fls. sky-blue, 1½ in. across; sepals 10–12, elongated, obtuse; anthers white. March, Apr. Woods, Italy. Gn. 72, p. 482.—This and a form with whitish fls. are both well suited for shady nooks in clumps of shrubbery, etc. Var. **Allenii,** Hort. Fls. large, pale blue. Var. **plèna,** Hort. Fls. double. Var. **purpùrea,** Hort. Fls. bright mauve. Gn. 72, p. 254.

14. **blánda,** Schott & Kotschy. St. 4–6 in. high, from a cylindrical rootstock: lvs. like *A. apennina,* but harder and smoother, and principal divisions sessile: fls. intense sky-blue, differing from above species in being larger, more finely rayed, styles black-pointed, and sepals smooth on the outside; opens in earliest spring or mild winter weather. From Taurus Mts. and Greece; rocky places. Intro. 1898. Gn. 14:200; 75 p. 152. G.L. 19:71. Gn. W. 22: Supp. Apr. 15 (var. *atrocærulea*). G.C. III. 41:297. (var. *Scythissica*).

DD. *Rootstock slender, creeping, cylindrical.*

15. **nemoròsa,** Linn. (*A. intermèdia,* Winkl.). WOOD ANEMONE. Fig. 205. St. simple, 3–8 in., nearly smooth: rootstock horizontal, 3–4 times the st. in diam.: lvs. of involucre petioled, 3–5-parted; basal lvs. appearing after the fl.-st., 5-parted, divisions wedge-shaped, toothed: fls. white or purplish, solitary, 1 in. across: achenes pubescent; styles hooked. Apr., May. Eu. and Siberia. Gn. 63, p. 244 (as *A. intermedia*).—Three or more horticultural varieties. Var. **álba,** Hort. (var. *flòre-plèno,* Hort.). Fls. larger, pure white, and abundant. Intro. 1883. Gn. 32:344; 69, p. 233 (var. *grandiflora*): 75, p. 128 (var. *purpurea*). G. 24:255 (var. *major*). Var. **Allenii,** Hort. Fls. large, lavender-mauve. Var. **màjor,** Hort. A robust variety with large white fls. Var. **Robinsoniàna,** Hort. (var. *cærùlea,* Hort.). A robust form, 6–12 in., with broader and thicker lvs., and large fls., becoming blue. Sometimes given as a separate species. March, Apr. Gn. 46, p. 153; 32, p. 345; 73, p. 266. G. 2:515. R.H. 1901:188. Var. **ròsea,** Hort. (var. *rùbra flòre-plèno,* Hort.). Fls. a reddish purple: now much used; suited to partially shaded places of the perennial border.

16. **quinquefòlia,** Linn. (*A. nemoròsa* var. *quinquefòlia,* Gray). This American species differs from *A. nemorosa* in having smaller fls., involucral lvs. less lobed, foliage paler, and much more slender st. and petioles.—The common windflower or spring anemone, formerly called *A. nemorosa.* Gn.M. 13:15.

17. **deltoídea,** Douglas. St. simple, slender, 6–12 in. high, from a slender rootstock: lvs. trifoliate, basal ones petioled, others nearly sessile, coarsely crenated, often incised: fls. solitary, white, rather large: achenes several, densely pubescent; style very short. Spring. Pacific slope.

DDD. *Rootstock horizontal, fleshy or somewhat tuberous.*

18. **ranunculoìdes,** Linn. YELLOW WOOD ANEMONE. St. 3–8 in., from elongated, somewhat tuberous rootstock: lvs. 3–5-parted, divisions deeply cut and serrated: fls. golden yellow, usually solitary, single or semi-double. March and Apr. Rich, light soil in open places and woods. Eu. and Siberia. Gn. 35:408. L.B.C. 6:556.

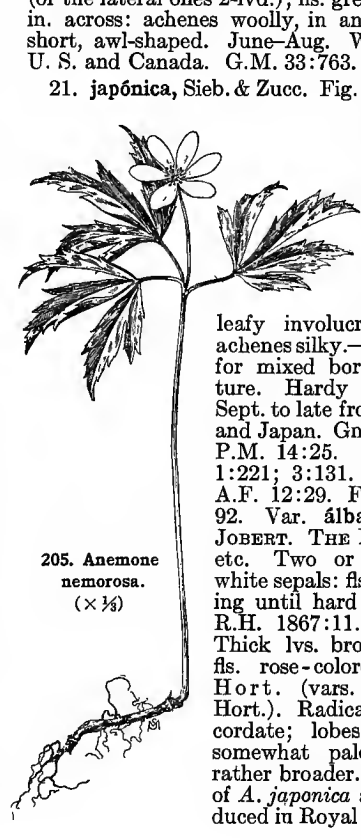
19. **Grâyi,** Behr. (*A. oregàna,* Gray). St. slender, 3–12 in. high, from a fleshy, brittle rootstock: basal lvs. slender-petioled, 3-parted, coarsely serrate; involucral lvs. petioled, trifoliate, the parts 2–3-lobed, much toothed; sepals blue or purplish: achenes pubescent, in a globose head. Moist, shady slopes. Ore. and Wash. In gardens west of the Rockies. Intro. 1892.

BB. *Peduncles 2–5 (mostly 3).*

C. *Frs. (achenes) woolly or very silky: secondary involucre present.*

20. **virginiàna,** Linn. Plant hairy, 2–3 ft. high, stout, branching at the involucre: the petioled involucral lvs. 3-parted, the lfts. cleft and lobed; basal lvs. similar, broader than long, on long petioles: fl. peduncles naked (or the lateral ones 2-lvd.); fls. greenish or white, 1–1½ in. across: achenes woolly, in an oblong head; styles short, awl-shaped. June–Aug. Woods and meadows, U. S. and Canada. G.M. 33:763.

21. **japónica,** Sieb. & Zucc. Fig. 206. Stately, branching st., 2–3 ft. high: plant soft and downy, with short hairs: lvs. ternate, much lobed and toothed: fls. rosy purple or carmine; 1–3 whorls of sepals, 2–3 in. diam., on long peduncles from leafy involucre; stamens yellow: achenes silky.—A very useful species for mixed borders or for pot culture. Hardy in northern states. Sept. to late frosts. Rich soil, China and Japan. Gn. 30:172. B.M. 4341. P.M. 14:25. A.G. 19:305. Gng. 1:221; 3:131. G.C. III. 16:661. A.F. 12:29. F.S. 2:74. Gt. 61, p. 92. Var. **álba,** Hort. HONORINE JOBERT. THE BRIDE. WHIRLWIND, etc. Two or 3 whorls of large, white sepals: fls. 2–3 in. across, lasting until hard frosts. Gng. 5:117. R.H. 1867:11. Var. **crìspa,** Hort. Thick lvs. bronzed on the edges: fls. rose-colored. Var. **hýbrida,** Hort. (vars. *ròsea* and *élegans,* Hort.). Radical lvs. 5-lobed, often cordate; lobes twice serrate: fls. somewhat paler, earlier; sepals rather broader. Said to be a hybrid of *A. japonica* and *A. vitifolia;* produced in Royal Gardens, 1848. Var.



205. Anemone nemorosa. (×⅓)

rùbra, Hort. LADY ARDILAUN. Probably the same as the type, but having lvs. and fls. with a waxy gloss: plant 4–5 ft. high.

22. **multífida,** Poir. Plant silky-hairy, somewhat branched, ½–1½ ft. high, from a branched, upright rootstock: main involucre 2–3-lvd., others 2-lvd. or naked, short petioles, similar to the root-lvs., 2–3 times 3-parted and cleft, divisions linear: fls. ½–1 in. across, red, varying to white or yellow: achenes very woolly. Early summer. Rocks and uplands. Middle states to Hudson Bay.

cc. *Frs.* (*achenes*) *glabrous at first: fls. white, somewhat umbellate.*

23. **canadénsis,** Linn. (*A. pennsylvánica,* Linn. *A. dichótoma,* Michx., not Linn.). Hairy, stout, 1–2 ft. high, branching at or above the involucre: the 3 lvs. of main involucre sessile, 3-cleft; upper involucres each 2-lvd.; basal lvs. broader than long, much divided, cleft and toothed; petioles long: fls. white, 1–2 in. across: achenes wing-margined, naked, becoming pubescent, grouped into a spherical head. Summer. In shaded woods and open meadows. N. Amer. Gng. 2: 21. Gn. M. 13:355.

24. **narcissiflòra,** Linn. (*A. umbellàta,* Lam.). St. erect, rather stout, ½–1½ ft. high: lvs. of involucre sessile; basal lvs. petioled, 3–5-parted, divisions deeply cut: fls. white, ½–1 in. across, several in an umbel; anthers yellow: achenes smooth, with short style. May–July. Mountainous regions. Northern hemisphere. Gn. 30, p. 173. B.M. 1120. G. 6:309.

A. acutilòba=Hepatica acutiloba.—*A. álba,* Juss. Allied to A. sylvestris, if not the same. L.B.C. 4:322. B.M. 2167.—*A. Bungeàna,* Pritz. Similar in habit to *A.* Pulsatilla. Fls. golden yellow. Siberia.—*A. cèrnua,* Thunb. Lvs. deeply cut, divided: fls. nodding, color of dragon's-blood. Japan.—*A. cylíndrica,* Gray. A tall native species, used for beauty of foliage and fr.—*A. decapétala,* Ard. (A. trilobata, Juss. A. beterophylla, Nutt.). Native and reported as having been cultivated in southern states. 1891.—*A. elongàta,* D. Don. Similar in habit and foliage to A. sylvestris but not so beautiful: fls. dull greenish white. Himalaya.—*A. Fánninii,* Haw. Fls. pure white, 2–3 in. across: 5 feet high: lvs. 1 ft. across. B.M. 6958. Gn. 34:202.—*A. hupehénsis,* Hort. Allied to A. japonica. Fls. produced very early. Cent. China.—*A. magellánica,* Hort. Fls. yellow: pretty but not showy. Straits of Magellan.—*A. parviflòra,* Michx. Pretty white fls. Native of northern states and Canada.—*A. polyánthus,* Don. Allied to A. narcissiflora. B.M. 6840. J.H. III. 32:259.—*A. praténsis,* Linn. Allied to A. Pulsatilla. L.B.C. 9:900.—*A. praténsis* var. *obsolèta,* Sims. Fls. pale: lfts. terminated with a sort of bristle. B.M. 1863.—*A. rivulàris,* Bush-Ham. Is a distinct species similar to A. narcissiflora. G. 18:138.—*A. sphenophýlla,* Poepp. Fls. blue. S.W. U. S.—*A. thalictroides.* See Syndesmon.—*A. trifòlia,* Linn. Lvs. beautifully regular: fls. white, 1 in. across. Two blue varieties. B.M. 6846.—*A. triloba*=Hepatica triloba.—*A. vitifòlia,* Ham. Allied to A. japonica. Has cordate 5–7-parted lvs. B.M. 3376.

K. C. DAVIS.

ANEMONÉLLA: *Syndesmon.*

ANEMONÓPSIS (*Anemone-like*). *Ranunculàceæ.* A beautiful hardy plant for border purposes because of its effective foliage and showy flowers.

This is a perennial herb, with erect sts.: radical and st.-lvs. rather large, ternately compound and much incised, similar to Actæa: sepals many (often only 9), regular, petal-like, deciduous; petals many (often 12), short, sessile, with nectariferous impression at the base; carpels few (3–4), forming many-seeded follicles. In general appearance similar to the Japanese anemones, but smaller in all its parts, and with numerous drooping fls., about 1½ in. across, of pale purple color. A monotypic genus from Japan, now planted in American gardens.

Anemonopsis thrives well in rich, deep loam, in well-drained situations in partial shade. Propagation is by division of the roots in late fall or early spring. Fresh seed may be sown in the fall or early the next spring and the plants will show some flowers the first season. Sow the seed in clean beds of black sandy loam, and cover very slightly.

macrophýlla, Sieb. & Zucc. The petals, instead of spreading, form a half-closed bud-like cone within the sepals. Gn. 25, p. 383. K. C. DAVIS.

ANEMOPÆGMA: *Bignonia.*

ANEMÓPSIS (Greek, from the resemblance of its fl.-cluster to the flower of an anemone). *Saururàceæ.* YERBA MANSA. Aquatic herb, yielding medicinal products.

A monotypic genus closely allied to Houttuynia of E. Asia. Stoloniferous aquatic plant with pungent aromatic rootstocks: lvs. mostly radical, minutely punctate: infl. a conical spike or spadix subtended by an involucre of petal-like bracts, resembling the fl. of an anemone; fls. small without calyx or corolla, each subtended by a bractlet; stamens 6–8, with short filaments adnate to the ovary at the base; ovary sunk in the rachis of the spike, 1-celled, composed of 3 or 4 carpels, with as many spreading stigmas and parietal 4–10-ovuled placentæ; caps. dehiscent at the top; seeds rounded, punctulate. Calif. and Mex.

califórnica, Hook. (*Anèmia califórnica,* Nutt. *Houttuýnia califórnica,* Benth. & Hook. *Anemiópsis califórnica,* Endl.) YERBA MANSA. APACHE BEADS. VAVISA. An erect aquatic herb: radical lvs. long-petioled, oblong-obovate, cordate at the base; cauline lf. broad, clasping, from the axil of which grows a branchlet reduced to 1 or 2 lvs.: fls. minute, crowded, forming a conical spadix with a whorl of whitish petaloid bracts below it, giving it the appearance of the fl. of an anemone. Calif. and Mex. Hook. & Arn. Bot. Beech. Voy. pl. 92. —The pungent aromatic astringent rootstocks are strung into necklaces in the form of cylindrical beads by the Indians of the S. W. U. S., and are used medicinally in the form of an infusion for malaria, dysentery, and syphilis. They are also pulverized and applied locally to ulcers and malignant sores. The plant grows in swampy places and on the margins of springs and ponds more or less alkaline. The roots are gathered in the dry season in Mex. and sold in the local drug markets.

206. Anemone japonica.

W. E. SAFFORD.

ANÈTHUM: *Dill* and *Peucedanum*; also *Fennel.*

ANGADÈNIA: *Ontadenia.*

ANGÉLICA (supposed to have angelic healing virtues). *Umbellíferæ.* ANGELICA. Herbs, sometimes planted for ornament.

Stout: fls. small, white or greenish, in many-lvd. involucels: fr. fattened dorsally, with very prominent ribs.—A genus of 60 species in north temperate regions, and from New Zeal. Several of them are native to N. Amer. They are perennial herbs with compound lvs. and large umbels of white fls. not unlike the cow-parsnip (Heracleum). The word "angelica" is loosely applied to various plants. In the American tropics, it is used for some of the araliads. The angelica of vegetable gardens is *Archangelica officinalis.*

Cúrtisii, Buckl. Stout perennial, 2–5 ft., glabrous: lvs. 2–ternate, with quinate divisions, the lfts. thin, ovate-lanceolate, irregularly sharp-toothed. Pa. to N. C.—Grown for the subtropical effect of its finely cut, ample foliage. Intro. 1891 by H. P. Kelsey.

hirsûta, Muhl. (*A. villòsa,* B. S. P. *Archangélica hirsùta,* Torr. & Gray). Pubescent above: lvs. twice pinnately or ternately divided, the lfts. thickish and serrate, the upper lvs. mostly reduced to sheathing petioles. Eastern states. Intro. 1892 by H. P. Kelsey. N. Taylor.†

ANGELÒNIA (South American name, *angelon,* of one of the species). *Scrophulariàceæ.* Perennial herbs or sub-shrubs, grown in hothouses and conservatories, and in the open far South.

Plants with the look of alonsoas: lvs. simple, opposite (or alternate above): fls. showy, blue, irregularly 2-lipped, the upper lip 2-lobed and the lower larger and 3-lobed; calyx 5-parted or 5-toothed; stamens 4, in pairs; ovary 2-celled. The axillary fls. are in a long, leafy terminal raceme: branches 4-sided.—About two dozen species from Mex. to Brazil. Grown as pot-plants in warm glasshouses and prop. by seeds or soft-wood cuttings.

salicariæfòlia, Humb. & Bonpl. Perennial, 3 ft. or less: lvs. lanceolate to ovate-lanceolate, sessile, toothed, closely pubescent: fls. deep blue. S. Amer. B.M. 2478. P.M. 5:75. B.R. 415.

Gárdneri, Hook. Woody, 3 ft.: lvs. linear-lanceolate, more strongly toothed throughout their length: fls. purple, white-centered, handsome, in a long terminal leafy raceme or spike: plant pubescent-glandular and aromatic. Brazil. B.M. 3754.

grandiflòra, Hort. (C. Morr.?). Perennial; graceful, 2 ft.: lvs. entire, or slightly toothed, lance-pointed: fls. lilac, fragrant, solitary, not exceeding the lvs., the lobes prominent and spreading. S. Amer.—An excellent plant for winter bloom, particularly the white-fld. var. **álba,** Hort., and grown in the open satisfactorily in Fla. It is a good pot-plant for conservatory or for table decoration. Blooming plants are secured the same year the seeds are sown. Intro. 1897 in Eu. Gt. 46, p. 612; G.C. III. 22:307; Gn. 52, p. 461; R.B. 23:272; all the same picture of a pot-plant of var. *alba.*

angustifòlia, Benth. Lower: lvs. smooth, narrow-lanceolate: fls. deep violet in erect terminal racemes. Mex.

cornígera, Hook. Annual, 1 ft. or more; slightly hirsute: lvs. lanceolate, practically sessile, broad at the base, slightly ciliate: fls. solitary in the axils, shorter than the lvs., rich purple and deeper colored in the throat, the upper segms. velvety-dotted, the middle segm. of the lower lip bearing a horn-like process (whence the name *cornigera,* "horned"). Brazil. B.M. 3848.

integérrima, Spreng. Perennial, with fleshy root, branching above: lvs. lanceolate, entire, narrowed at base: fls. stalked in the axils of short bracts and forming a terminal spike or raceme 6 in. long, light blue- and purple-spotted, the throat wide open and lobes very short and rounded except the lower which is broad-ovate and toothed. S. Brazil, Paraguay. Gt. 54:1538. L. H. B.

ANGIÓPTERIS (Greek, *vessel-fern*). *Marattiàceæ.* An Old World genus of coarse greenhouse ferns, with twice- or thrice-pinnate lvs., and the large fleshy sporangia arranged in boat-shaped marginal sori. In cult., requires plenty of room and abundant drainage.

Angiopteris grows wild in swampy places, and is of robust habit. If grown in pots, the pots may stand in 2 or 3 inches of water. Although spores are freely produced, no seedlings are on record. Easily propagated by the fleshy scales at the base of each frond. Each scale contains at least two dormant buds, and should not be divided. They may be laid in sand, covered with sphagnum, and kept in a close case for three to five months. They start more quickly in early spring. (Schneider, Book of Choice Ferns.)

evécta, Hoffm. Growing from a stout, fleshy, erect caudix, 2–6 ft. high: lvs. 6–15 ft. long, mostly bipinnate, with swollen rachises; lfts. 4–12 in. long, ½–1½ in. wide, the margin entire or slightly toothed. India and Japan to Madagascar and Queensland. S. 1:399.—Known under various names in cult., as *A. longifolia,* etc. The trade names, which appear to indicate species, may be regarded as varieties. R. C. Benedict.†

ANGÓPHORA (*vessel-bearing;* Greek, in allusion to shape of fruit). *Myrtàceæ.* Gum Myrtle. A genus of 4 species of Australian trees or shrubs, sometimes cult. in glasshouses in the Old World, but not known to the trade in this country, where their cult. seems to be confined to botanic gardens. They have large opposite lvs., corymbose fls., with a 5–6-cleft calyx. The commonest species in cult. are *A. cordifòlia,* Cav., with yellowish fls. and sessile lvs., and *A. lanceolàta,* Cav., with white fls. and petiolate lvs. See page 3565.

ANGRÆCUM (Latinized from *Angrek,* the Malay name for all orchids of this habit). *Orchidàceæ.* Epiphytic hothouse orchids with the habit of Vanda.

Leaves flat or terete: fls. few to many in a raceme, or rarely solitary; sepals and petals nearly alike, spreading; lip adnate to the base of the column; lateral lobes small or obsolete; middle lobe entire; spur long and slender; pollinia 2, upon a single undivided stipe.—About 20 species, natives of Trop. Afr., Madagascar, and the Mascarene Isls.

These are valued for their winter-flowering habit and lasting qualities. All have peculiar or grotesque forms and some are fragrant. All need a warmhouse in winter, preferably the warmest corner, where it is moist. As the plants have no pseudobulbs they must never become dry. No soil is necessary at the roots, but a surfacing of live sphagnum may be placed over the crocks; this should be renewed as often as it becomes decayed. The angræcums may be classed with the aërides, vandas and saccolabiums as being true air-plants and the roots are impatient of confinement in pots or other receptacles. Care must be taken to secure the plants firm and upright when repotting, by means of stakes or wire. Frequent spraying overhead in bright weather is of great assistance, especially in the growing time. They must never be removed from the greenhouse for decoration elsewhere, for if the plants become chilled, there is total loss. (Orpet.)

A. *Lvs. semi-terete, narrow.*

Scottiànum, Reichb. f. Sts. up to 2 ft. long, with brown sheaths below: lvs. terete, grooved on the upper side, 3–4 in. long, spreading or recurved: peduncles with 1–3 fls. which are inverted and 1½–2 in. across, the sepals and petals pale yellow, changing to white, linear, similar, acute, the sepals a little broader than the petals, the lip white, concave, transversely oblong, mucronate; spur 4–5 in. long, reddish brown. Comoro Isls. G.C. II. 14, p. 137. F.M. 1880:421. B.M. 6723.

AA. *Lvs. flat.*

B. *Plant dwarf: fls. few, 3–5, the clusters shorter than the lvs.*

falcâtum, Lindl. St. 1–2 in. tall: lvs. few, linear, falcate, 2–3 in. long, channeled above, keeled beneath: peduncles with 3–5 fls., fragrant, white, about ¾ in. across, the sepals and petals acute, similar, linear-oblong; lip 3-lobed, the lateral lobes minute, the middle lobe narrow-oblong, retuse; spur curved, filiform. Japan. B.R. 4:283. B.M. 2097 (both as *Limodorum falcatum*).

BB. *Plant larger than above: fls. numerous, in racemes usually longer than the lvs.*

C. *Fls. white or tinged with yellow.*

D. *Lip acute.*

E. *Spur less than 5 in. long, white.*

F. *Sepals lanceolate: fls. about 1 in. across; spur 2–3 in. long.*

modéstum, Hook. f. (*A. Sanderiànum,* Reichb. f.). Lvs. oblong to obovate-oblong, acutish to emarginate, 3–6 in. long: racemes of numerous pure white fls. on orange pedicels; sepals lanceolate; petals ovate-lanceolate; lip broadly ovate. Madagascar and Comoro Isls. B.M. 6693. Lind. 2:92. R.H. 1888, p. 516. R.B. 15: 217. A.F. 22:951; 35:381. O.R. 8:152; 12:337. O. 4: f. 24.

FF. *Sepals elliptic: fls. about 1¼ in. across; spur 3–4 in. long.*

articulàtum, Reichb. (*A. descéndens,* Reichb.). Lvs. oval to obovate-oblong, 3–5 in. long, emarginate or 2-lobed: racemes pendulous, of numerous pure white fls. on pale orange pedicels; sepals and petals elliptic-oblong, acute, the lateral sepals narrower; lip broadly oblong-oval, acute; spur 3–4 in. long. Madagascar.

EE. *Spur 6–7 in. long, tinged with orange-red.*

Éllisii, Reichb. Sts. up to 1 ft. high: lvs. narrow, oblong, 5–8 in. long, emarginate or bilobed at apex: racemes pendulous, of 12 or more pure white fls.; sepals and petals elliptic-oblong, acute, the dorsal sepal inflexed at the summit, the lateral reflexed; lip oblong-elliptic, acute; spur slender, tinged with orange-red. Madagascar. G.C. II. 3: 277. F.M. 1875:191. O.R. 7:81.

DD. *Lip emarginate or 2-lobed at apex.*

citràtum, Thouars. Sts. 3–4 in. high: lvs. oblong-ovate, 3–5 in. long, acute or lobed at the apex: racemes pendulous, of 12 or more white or pale straw-color fls.; sepals obovate, obtuse; petals oblong-elliptic; lip flat, nearly orbicular, emarginate; spur slender. Madagascar. B.M. 5624. I.H. 33:592. Lind. 5:238.

CC. *Fls. with green sepals and petals; lip white.*

supérbum, Thouars (*A. ebúrneum,* Lindl.). Fig. 207. Sts. up to 4 ft. or more long: lvs. up to 2 ft. long, 2 in. wide, coriaceous: racemes ascending, with 8 or more fls.; sepals and petals spreading, green, lanceolate; lip white, orbicular, fleshy, abruptly acuminate; spur green. Madagascar. B.M. 4761. B.R. 1522. Var. **vìrens,** Veitch (*A. virens,* Lindl.). Differs from the type in its smaller fls. with the labellum tinged green. B.M. 5170.

A. augústum, Rolfe (A. Augustii) Allied to A. Kotschyi. Lvs. thick and fleshy, glaucous green: fls. in arched raceme, pure white, spur pale green. G.C. III. 45:Feb. 6, Suppl. O.R. 1908:246. Rhodesia.—*A. bilobum,* Lindl. Racemes of 6–10 fls, about 1 in. across, the sepals, petals and lips nearly alike, lanceolate-acuminate, the spur pale orange-red. W. Afr. J.H. III. 43:483.—*A. Buyssònii,* God. Resembles A. articulatum: fls. pure white; brown spurs. Madagascar.—*A. caudàtum,* Lindl. =Listrostachys caudata.—*A. Chailluànum,* Hook. =Listrostachys Chailluanum.—*A. dístichum,* Lindl.=Mystacidium distichum.—*A. Eihleriànum,* Kränzl. (A. Arnoldianum, DeWild). St. elongated: lvs. distant: fls. large, solitary; sepals and petals oval-lanceolate, acuminate; lip large, extinguisher-shaped, emarginate and apiculate at the summit; spur about as long as lateral sepals. Afr. B.M. 7813. A.F. 25:79. Gng. 13: 377.—*A. expánsum,* Thouars. Fls. white, of peculiar form; spur longer than perianth segms. Mascarene Isls.—*A. fastuòsum,* Reichb. St. 1–2 in. high: racemes of 2–4 fls. about 1½ in. diam., pure white, the slender spur about 3 in. long. Madagascar. J.H. III. 42:297.—*A. fuscátum,* Reichb. Sts. short: racemes of numerous fls., 1–1½ in. across, cream-white, the lip oblong, acuminate abruptly, the slender spur about 3 in. long. Madagascar. Gn. 37, p. 61.—*A. Humblòtii,* Reichb.=Macroplectrum Leonis.—*A. ichneumòneum,* Lindl.=Listrostachys ichneumoneum.—*A. infundíbulare,* Lindl. Sts. long: fls. large, solitary; sepals and petals pale yellow; lip funnel-shaped, 2½–3 in. long, white with a green throat, the curved spur 3–5 in. long. W. Afr. B.M. 8153. G.C. III.36:130. G.M. 47:629. Gn. 66, p. 109. J.H. III. 49:219; 59:387.—*A. Kotschyi,* Reichb. Lvs. obovate-oblong, 3–7 in. long: raceme of 6–10 white fls., 1½ in. across, the ovate-oblong dorsal sepals and petals reflexed, the spreading lateral sepals lanceolate; lip nearly rhomboid, with a broad claw; spur pale brown, up to 9 in. long. E. Afr. G.C. II. 14:693; III. 39:379; III. 46:221. Gn. 31, p. 323; 37, p. 101; 75, p. 583.—*A. Leònis,* Veitch=Macroplectrum Leonis.—*A. pellùcidum,* Lindl. =Listrostachys pellucida.—*A. pertùsum,* Lindl.=Listrostachys pertusa.—*A. Rothschildiànum,* J. O'Brien. Sts. 3–6 in.: lvs. ovate, 4–8 in. long: racemes of 10–12 fragrant white fls., with a pale green band along the sepals and petals, the lip white with an emerald center and black-purple throat, the spur green with a brown tip. Cent. Afr. G.C. III. 34 : 131.—*A. Schéfflerì,* Hort. Scarcely 8 in. high: fls. long, reddish brown. German E. Afr. Var. *virens* differs from the type in having all the vegetative parts green.—*A. sesquipedàle* = Macroplectrum sesquipedale.

GEORGE V. NASH.

207. Angræcum superbum. (×⅙)

ANGULÒA (dedicated to Don Francisco de Angulo). *Orchidàceæ.* Stout coolhouse orchids, with large pseudobulbs, the scales at the base passing into lvs.

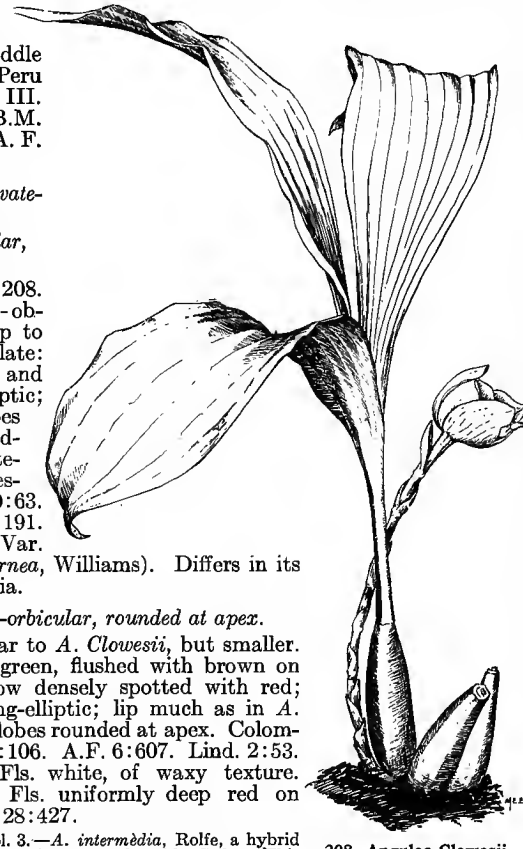
Leaves large, plicately nerved: scapes from the base of the pseudobulbs, clothed with large lax sheaths; fls. subglobular; sepals and petals connivent, fleshy; lip shorter than sepals and petals, 3-lobed, the middle lobe much smaller than the lateral lobes, linear and recurved, or broader and 2-lipped.—Species 3, all in cult., natives of S. American Andes, at elevations of 5,000–7,000 ft.

This interesting genus comprises but few species, but these are singular, since all are well worthy of culture. Coming from the Andes of Colombia, a moderate temperature of 50° in winter will be ample for their needs, and a cool, shaded structure in summer, as the foliage is easily scorched by direct sunlight in hot weather. The peculiar structure of the flowers has given the popular name of "boat orchid," which suggests the general shape. This, together with the fragrance, and the hinged lip, which oscillates with the least movement, makes the plants very interesting when in bloom. The anguloas are rather terrestrial than epiphytal. The culture is very simple if, as a potting compost, a mixture is used containing some soil with the fiber and some sphagnum moss as a surfacing, the potting being very firm. Propagation is simple by division of the bulbs. The old back ones may be severed at the creeping rhizome after the new growth

has been completed, and these will start new shoots usually in spring. Division must be made after the shoots are visible from the back bulbs. The black-spot disease of the bulbs is often fatal to anguloas. It appears suddenly and is generally due to too much moisture in the atmosphere or at the roots. Directly it is seen, the affected parts must be cut out clean, and dry sulfur applied; this, if done in time, will stop the progress of the disease. If brown scale attacks the plants, sponge with soap and water, taking care not to injure the tender leaves. (Orpet.)

A. *Middle lobe of lip linear, recurved.*

uniflòra, Ruiz & Pav. (*A. virginàlis*, Hort.). Pseudobulbs angled, ovate-oblong, 3–6 in. long: lvs. up to 2 ft. long, broadly lanceolate: fls. creamy white, often flushed or spotted internally with pink; sepals ovate, acute; petals oblong-elliptic, acute; lateral lobes of lip semi-orbicular, rounded at apex, the middle lobe linear, recurved. Peru and Colombia. G.C. III. 19:423. B.R. 30:60. B.M. 4807. Gt. 32:1137. A. F. 6:607.



208. Anguloa Clowesii. (×¼)

AA. *Middle lobe of lip ovate-triangular, 2-lipped.*

B. *Lateral lobes triangular, acute.*

Clówesii, Lindl. Fig. 208. Pseudobulbs cylindric-oblong, 4–6 in. long: lvs. up to 2 ft. long, obovate-lanceolate: fls. lemon-yellow; sepals and petals acute, oblong-elliptic; lip with the lateral lobes triangular, acute, the middle lobe broadly ovate-triangular, fleshy, pubescent. Colombia. B.R. 30:63. B.M. 4313. Lind. 4:191. Veitch, Man. pl. p. 100. Var. **ebúrnea,** Veitch (*A. ebúrnea*, Williams). Differs in its ivory-white fls. Colombia.

BB. *Lateral lobes semi-orbicular, rounded at apex.*

Rúckeri, Lindl. Similar to *A. Clowesii*, but smaller. Fls. green or yellowish green, flushed with brown on the outside, inside yellow densely spotted with red; sepals and petals oblong-elliptic; lip much as in *A. Clowesii*, but the lateral lobes rounded at apex. Colombia. B.R. 32:41. Gt. 3:106. A.F. 6:607. Lind. 2:53. Var. **albiflòra,** Veitch. Fls. white, of waxy texture. Var. **sanguínea,** Lindl. Fls. uniformly deep red on inside. B.H. 3:31. I.H. 28:427.

A. Clíftonii, Hort. O. 4, pl. 3.—*A. intermèdia*, Rolfe, a hybrid between A. Ruckeri and A. Clowesii, was produced by Seden. This had fls. of nearly the size and shape of A. Ruckeri.

GEORGE V. NASH.

ANHALÒNIUM. *Cactàceæ.* A name used in the first edition of this Cyclopedia, but now given place to the slightly older name *Ariocarpus*, which see. *A. Williamsii* and *A. Lewinii*, sometimes referred to Echinocactus or to Mamillaria, are here treated under *Lophophora*, which see.

ANIGOZÁNTHOS (Greek, *expanded flower*). *Amaryllidàceæ.* AUSTRALIAN SWORD LILY. About 8 Australian greenhouse or half-hardy perennials with sword-like lvs. and woolly-yellow, -green, or -red fls. in short 1-sided racemes or spikes and a much elongated perianth-tube. The two species likely to be met with are **A. flávida,** Red. (*A. coccínea*, Paxt.), with mostly red-woolly fls. 1¼ in. long and appendaged anthers; and **A. Mánglesii,** Don, with fls. about 3 in. long, red-woolly at base and green beyond, the anthers not appendaged. These plants are little known in N. Amer.

ANISACÁNTHUS (Greek, *unequal acanthus*). *Acanthàceæ.* A genus of 6 species of Mexican and American shrubs, with mostly lanceolate, entire, petioled opposite or clustered lvs., and loosely spicate or scattered red fls. 1 in or more long; corolla-lobes 4, the tube 2-lipped, the upper lip 3-parted, the lower entire; stamens 2, equaling or exceeding the corolla-lobes.

Wrightii, Gray. Height, 2–4 ft.: lvs. 1–2 in. long, oblong- or ovate-lanceolate, acute or acuminate: fls. racemose, or paniculate-racemose, the corolla vermilion or purplish red, 1½–2 in. long, the lip shorter than the tube; calyx deeply 5-cleft. S. and W. Texas. Offered by Franceschi of Santa Barbara, Calif.

Gonzalèzii, Greenm. (*A. Conzàttii*, Hort.). Sub-shrub, the st. much branched: lvs. 1–2 in. long, ½–¾in. wide, acuminate, and obtuse at the apex: fls. cymose-racemose, brick-red, or scarlet and larger than in the preceding. Oaxaca, Mex.—Suitable for dry places. Intro. by Franceschi in 1911. N. TAYLOR.†

ANISE. *Umbellíferæ.* An aromatic condimental and medicinal herb.

Anise (*Pimpinélla Anìsum*, Linn.) is an annual, easily grown from seeds in any warm and mellow soil. The seeds are commonly sown where the plants are to stand, and the plant matures rapidly. The seeds are used in medicine and in cookery, and for flavoring liquors; they yield a highly perfumed essential oil; they are mostly grown in Mediterranean countries. The lvs. are also used as seasoning and garnishing. The plant reaches a height of 2 ft. or less, bears twice-pinnate lvs. and small yellowish white fls. in large, loose umbels. The seeds are oblong and curved, ribbed on the convex side, grayish, the size of caraway seed. In common with all umbelliferous seed, anise seed does not retain its vitality long, the normal longevity being 1–3 years. Native from Greece to Egypt. L. H. B.

ANISÒTES (Greek, *unlikeness*). *Acanthàceæ.* Broad-leaved shrubs of about 4 Arabian and African species, one of which has been intro. to cult. recently. Fls. in short axillary clusters; sepals 5, nearly free; corolla 2-lipped, in shades of red; stamens 2, the filaments long and glabrous: fr. a caps. **A. diversifòlius,** Balf., from the Isl. of Socotra, is an erect nearly glabrous shrub less than 2 ft. high: lvs. elliptic-ovate or obovate, 2 in. or less long, flame-colored or yellow, tubular and 2-lipped, the lips curved. B.M. 8219.—Warm greenhouse, blooming spring and summer. Requires the treatment given to Justicia and Jacobinia. Prop. easily by cuttings. L. H. B.

ANÌSUM. An old generic name now referred to Pimpinella. *A. officinale*, D.C. (P. Anisum) is *Anise*, which see.

ANNÒNA (Latin, *year's harvest*, suggested by the Haitian name *anon* applied to one of the species. Commonly spelled *Anona*, but Linnæus used the double *n*). *Annonàceæ* (Richard, 1808). CUSTARD-APPLE. ARATICÚ. Tropical and subtropical woody plants cultivated for their fleshy fruits and for ornament.

Leaves 2-ranked, alternate, devoid of stipules: fls. perfect, solitary or in clusters, extra-axillary, often opposite the lvs. and sometimes subterminal; calyx usually gamosepalous, 3-parted; petals typically 6, in 2 series, but the inner series in some species reduced to small scales or even wanting; stamens numerous, crowded on the receptacle, the fleshy filament bearing a pair of linear parallel pollen-sacs on its back, these opening extrorsely by a longitudinal slit and capped by the expanded hood-like connective; pistils many, the ovaries usually clothed on the outside with minute hairs and containing a single erect ovule at the base: fr. a syncarpium, formed by the growing together of the carpels and receptacle into a fleshy mass; seeds containing a large wrinkled endosperm with small basal embryo.—Trees and shrubs, over 50 in number, chiefly from Trop. Amer., but a few from Afr., and several now widely cult. in the warmer regions of both hemispheres.

Several species have been successfully introduced into southern California and Florida. Some of those cited in catalogues and horticultural publications are merely forms of old species and others are generically distinct. Amongst these names are *A. mexicana*, which was a catalogue name used by Loddiges; *A. excelsa* of Humboldt & Bonpland, a species never fully described, the flowers and fruit of which are entirely unknown; and *A. africana*, an obscure species based by Linnæus upon an American specimen with lanceolate, pubescent leaves. *A. trilobata* and *A. obovata* are *Asimina triloba* and *Asimina obovata*; *A. asiatica* of Linnæus is not an annona at all but a rubiaceous plant, *Morinda citrifolia;* while *A. asiatica* of Loureiro is *A. reticulata*, and *A. asiatica* of Vahl is *A. squamosa*. *A. Forskahlii* of De Candolle (*A. glabra*, Forsk., not Linn.) was based upon a specimen of *A. squamosa* growing in cultivation in Egypt; to *A. squamosa* must also be referred *A. biflora* of Mociño & Sessé, while *A. longifolia* of these authors is undoubtedly *A. reticulata*, and their *A. fruticosa* is *A. globiflora* of Schlechtendahl. *A. aurantiaca* and *A. macrocarpa* are Brazilian species, the names of which were erroneously applied to certain cultivated forms in southern California; while *A. suavissima* is only a horticultural variety of *A. Cherimola*, and *A. cinerea* of the Antilles a form of *A. squamosa*. *A. palustris* of Linnæus is identical with his previously described *A. glabra*, and the latter name must take precedence in accordance with accepted rules of priority. A number of species described as annonas belong to other genera. Among them are *A. amplexicaulis* and *A. grandiflora* of the islands of Mauritius and Madagascar, which belong to the genus Pseudannona. *A. Mannii* of Oliver, an African species which has a branching inflorescence very different from that of the genus Annona, has been assigned to a new genus Anonidium by Engler & Diels; and *A. Perottetia* of A. De Candolle has been placed in the genus Unonopsis by R. E. Fries. *Annona obtusiflora* of Tussac, together with *A. mucosa* of Jacquin, must be placed in the genus Rollinia under the name *R. mucosa*, and to this genus should also be assigned the Brazilian biriba, which is probably *Rollinia orthopetala*, a species with large, fleshy fruit of delicious flavor, successfully introduced into Florida from Para. The climbing *Annona uncinata* of Lamarck belongs to the genus Artabotrys. *A. pyriformis*, also a climbing shrub, of Mauritius, the fruit of which is unknown, belongs undoubtedly to some other genus. For *Annona longifolia* see *Duguetia*. See also *Rollinia*, *Artabotrys* and *Cananga*.

W. E. SAFFORD.

Cultural notes.

While the annonas succeed best on a heavy loam, most species can be grown on light soils and under adverse conditions. The custard-apple (*A. reticulata*) thrives on the Florida keys in a semi-naturalized state; the cherimoya (*A. Cherimola*) grows and bears abundantly on steep calcareous cliffs in Central America; the sugar-apple (*A. squamosa*) is successful on dry and sandy soils with practically no attention whatever. The situation best adapted to them is a sloping piece of ground, for, with the exception of *A. glabra*, they are intolerant of stagnant water about the roots.

The cherimoya, probably the hardiest of the genus, withstands temperatures as low as 26° F. without injury, and reaches perfection only in a comparatively cool climate. The soursop (*A. muricata*) is one of the tenderest species; the sugar-apple and the custard-apple are somewhat hardier; all three are successfully grown in southern Florida, but not in California.

Propagation is usually effected by means of seeds; the most highly valued species, however, such as the cherimoya, are budded or grafted.

Seeds will retain their vitality for several years, and if planted in warm weather or under glass will germinate in a few weeks. If in a greenhouse, they may be planted at any season of the year; otherwise, it is best to plant only during spring or early summer. Sow thickly in flats or pans of light, porous soil containing an abundance of humus, covering to the depth of ½ or ¾ inch. When the plants are 3 or 4 inches high, they should be potted into 3-inch pots; care should be taken to see that the soil is perfectly drained, and waterings should not be too frequent or copious. When the plants have attained a height of 8 or 10 inches, they may either be shifted into larger pots or set out in the open ground; in the latter case, they must have careful attention until they have become established and made considerable growth.

Both budding and grafting have proved to be readily applicable to the annonas, either in the open ground or in pots, under glass. Several different species have been used for stocks, *A. Cherimola* proving the most satisfactory thus far in California, as it is best adapted to that climate; *A. glabra* has been found to be the most vigorous and satisfactory in Florida.

Shield budding, essentially the same as practised with the citrous fruits, is the method most commonly used. The work is best done in spring, shortly after the sap has begun to flow, the time varying, of course, according to locality and season. Stocks should be from ⅜ to ½ inch in diameter; seedlings of this size will be eighteen months to two years old. Budwood from which the leaves have dropped, and of about a year's growth, is the most desirable. It is important that the buds be cut large,—about 1½ inches in length,—as they are likely to have difficulty in starting and be choked out, on account of the thick bark and rapid callousing of the annonas, if they are too small. The incision may be made either in the form of a T or an inverted T, raising the bark with care so that the delicate tissues lying under it will not be injured, and inserting the bud with as little pressure as possible. Waxed tape should be used for tying. Three or four weeks after insertion, the buds should be unwrapped, and, if they have united with the stock, re-wrapped loosely, lopping the stock at a point 5 or 6 inches above the bud. The wrap should not be removed until the bud has made a growth of several inches.

For grafting, two-year-old seedlings are used, the operation being a simple cleft-graft, using a scion of well-matured wood from which the leaves have dropped.

Cuttings of well-ripened wood can be rooted under glass, with bottom heat. This method of propagation is not widely practised, however.

The annonas, when grown from seed, vary greatly

in regard to productiveness as well as size, color, form, texture and quality of fruit. In southern California, many large seedling cherimoyas have been grubbed out because they were unproductive, while others produce fruit of such poor quality as to be of no value. Careful attention to culture will assist in improving the quality and size of the fruit, but the only sure way to perpetuate choice forms and eliminate all possibility of the tree turning out to be inferior is to propagate by some asexual means.

209. Annona muricata. (×⅛)

Most species come into bearing when three or four years old. Few named varieties have been established, and these are probably confined to the cherimoya.

In some countries, the annonas are subject to certain fungous diseases and insect pests, notably the mealy-bug. As a class, however, they seem to suffer less from these pests than most other fruit trees. They require very little pruning.

Fruits must be picked when mature,—to avoid their falling to the ground and becoming bruised,—and laid away for a few days before they are ready for eating. If they are to be shipped any distance, they must be packed in some material, such as excelsior or straw, that will allow good ventilation, each fruit being wrapped in a piece of strong paper. The selection of the toughest-skinned varieties adds greatly to the facility with which they can be shipped. F. W. Popenoe.

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A. *Petals broadly cordate-ovate or suborbicular, the inner ones somewhat smaller than the outer.*

B. *Exterior petals valvate or edge-to-edge, usually acute, inner ones imbricate or overlapping, obtuse or rounded.*

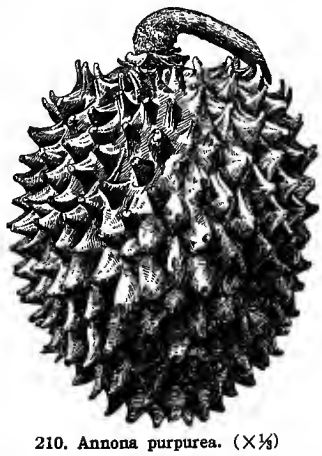
C. *Fr. glabrous, bearing fleshy spines: lvs. glossy leathery, with minute pockets in the axils of the lateral nerves.*

1. **muricàta**, Linn. Soursop. Guanábana. Corossol. Coração de Rainha. Graviola. Suirsaak. Zuursaak. Fig. 209. Small evergreen tree, the size of a peach tree, in general cult. throughout the tropics of both hemispheres: lvs. leathery, ill-smelling, obovate-oblong or oblanceolate, to ovate or elliptic, acute or abruptly acuminate, glossy above and rusty beneath but at length glabrous, with the minute pockets in the axils of the lateral veins scarcely perceptible without a lens: fls. large, the exterior petals thick and fleshy, ovate-acute, valvate or edge-to-edge, the interior petals somewhat smaller and thinner, concave, rounded, imbricate or overlapping: fr. very large, fleshy, often as large as a child's head and weighing as much as 5 lbs., ovoid or heart-shaped, dark green, the glabrous ill-smelling skin bearing numerous recurved fleshy spines; pulp white and juicy, pleasantly subacid, with a slight mango-like flavor. Of Trop. Amer. origin, but now common in the tropics of the Old World.—As in all cult. frs., there is more or less variation in its flavor. It is easily prop. from the seed or from buds, and is undoubtedly capable of improvement by selection. It begins to bear at a very early age and is consequently one of the most valuable fr. trees of the tropics. It is grown with especial excellence in Porto Rico, and is common in the markets of Key West, whither it is shipped from the islands to the southward. A favorite drink is made from the juice, and the pulp yields excellent jelly, tarts and preserves. Care must be taken, however, to remove the skin in preparing the fr. for the table.

2. **montàna**, Macfadyan (*A. muricàta*, Velloso, not Linn.). Mountain Soursop. Guanábana Cimarrona. Corossolier Bâtard. Araticũ Ponbẽ. A forest tree, sometimes reaching the height of 45 ft., but usually of smaller dimensions: lvs. resembling those of the soursop, varnished above and dull beneath, with the pits in the axils of the lateral nerves often conspicuous: fls. similar to those of the soursop, solitary or in pairs: fr. spheroid or broadly ovoid, varying from the size of an orange to 6 in. diam., green at first, at length turning yellowish; skin glabrous, bearing numerous short erect fleshy spines; pulp not edible. This species, which is larger and more robust than the closely allied *A. muricata*, has been intro. into Fla. for use as stock upon which to bud other species of the genus. W. Indies and N. S. Amer.; thus far unknown from Mex. and Cent. Amer.—The peculiar pits, or pockets in the axils of the lateral nerves of the lvs. set apart this species, together with *A. muricata*, from all other species of the genus.

CC. *Fr. covered with felt-like tomentum, bearing rigid stout pyramidal spines often hooked at the tip: lvs. very large, subcoriaceous or membranaceous, undulate without axillary pockets.*

3. **purpũrea**, Mociño & Sessé. Negro-head. Cabeza de Negro. Soncoya. Sencuya. Toreta. Fig. 210. A small or medium-sized tree, sometimes reaching the height of 25 ft., the younger branches clothed with reddish tomentum but becoming glabrate at length: lvs. large, membranaceous or subcoriaceous, undulate, oblong-elliptical to oblong-obovate, acuminate at the apex, rounded or obtusely cuneate at the base, 8–12 in. long and 4–5½ in. broad; petioles short and thick: fls. resembling those of *A. muricata* but sessile or nearly so, solitary, extra-axillary, sometimes opposite a lf., inclosed when very young in an involucre of 2 bracts, the apex of which becomes more or less shriveled at length, and the base persists somewhat like an outer or second calyx; calyx 3-lobed, ferrugineous-velvety on the outside; 3 outer petals very thick, valvate, usually acute or acuminate, sometimes obtuse at the apex, ferrugineous-velvety on the outside, stained with purple within; inner petals overlapping, thinner and rounded, forming a dome-like covering over the essential parts, whitish on the outside, purple within; terminal connectives of the stamens velvety; carpels distinct at first, the hirtellous ovaries crowned by a

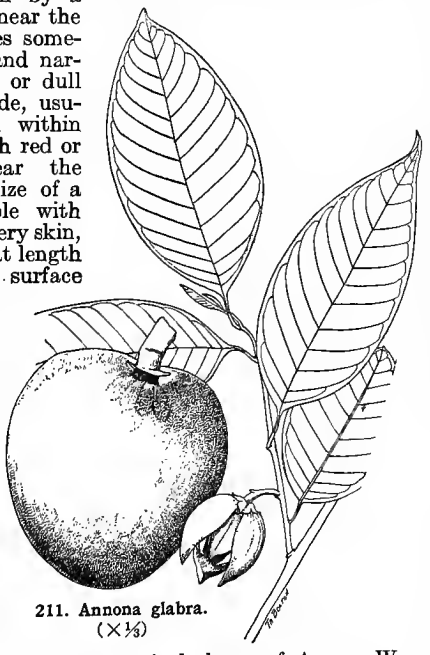


210. Annona purpurea. (×⅓)

prismatic style about ⅛in. long: fr. large, spheroid or broadly ovoid, sometimes 6–8 in. diam., covered with a brownish felt-like indumentum and bearing numerous pyramidal protuberances, grooved longitudinally on the ventral side and usually terminating in a hook directed toward the peduncle; seeds large, obovate, more or less flattened and marginate, sometimes exceeding an inch in length by ½–¾in. broad; pulp fleshy, fibrous, very fragrant, edible, with a flavor somewhat like that of a mango. Mex. to Panama and perhaps N. S. Amer. It is abundant on the Isthmus of Tehuantepec and is sold in the markets of Veracruz.—The frs. differ considerably in flavor. Some of those on the Isthmus of Panama are reputed to be excellent, though here, as elsewhere, they are supposed to induce chills and fever. Intro. into S. Calif., but imperfectly known in cult. Like its congeners, it is undoubtedly capable of improvement by careful selection.

BB. *Exterior and interior petals both valvate or edge-to-edge and usually acute.*

4. **glàbra,** Linn. (*A. palústris,* Linn. *A. laurifòlia,* Dunal). POND-APPLE. ALLIGATOR-APPLE. MONKEY-APPLE. MANGROVE-ANNONA. MAMIN. MAMAIN. CACHIMAN-COCHON. CAYUL. CAYURES. CORK-WOOD. PALO BOBO. BOIS-FLOT. CORCHO. CORTISSO. ARATICÚ DO BREJO. Fig. 211. Small to medium-sized tree, sometimes reaching a height of 45 ft., growing in swampy places and along the banks of streams; young growth smooth: lvs. smooth and laurel-like, glossy green above, paler beneath, evergreen, ovate to oblong or elliptic, usually acute or acuminate but sometimes bluntish at the apex and rounded or tapering at the base: fls. fragrant, varying considerably in size, those of trees growing in favorable situations larger than those growing in crowded mangrove swamps; outer petals cream-colored or pale greenish yellow when fresh, usually marked within by a deep red spot near the base; inner ones somewhat shorter and narrower, whitish or dull greenish outside, usually blood-red within or spotted with red or wine-color near the base: fr. the size of a bellflower apple with a smooth leathery skin, green at first, at length yellowish, its surface covered with indistinctly outlined areoles, but these never elevated or squamose; pulp cream-colored when ripe, not edible except by iguanas and other animals. Everglades of Fla. and banks of the Indian and Caloosahatchee Rivers; also the tropical shores of Amer., W. Indies, west coast of Afr., and the Galapagos Isls.—Statements that the fr. is sold in the markets of Mex. and that the tree is cult. for its fr. are based upon the confusion of other species of annona having smooth frs. with this. This species is essentially tropical and swamp-loving. Its light spongy roots are used as a substitute for cork and for floats of fishing-nets; hence its name cork-wood.



211. Annona glabra. (×⅛)

AA. *Petals (exterior) linear or oblong, the inner ones minute and scale-like.*

B. *Peduncles with broad persistent lf.-like bracts at the base.*

5. **diversifòlia,** Safford. ILAMA. ILAMATZAPOTL. Fig. 212. Small tree with brownish-gray, aromatic, longitudinally furrowed bark; young growth glabrous, with prominent lf.-scars bordered with a margin of pale rufous hairs: lvs. thin, membranaceous, glabrous, variable in form, those near the base of the branchlets broadly elliptical and rounded at the base, those higher up oblanceolate, rounded at the apex and acute or cuneate at the base, the largest 4–5½ inches long and 1½–2 inches broad with petioles exceeding ½inch in length: peduncles long and slender, recurved, glabrous, issuing from 2 suborbicular, lf.-like, amplexicaul bracts at the base of the branchlets; fl.-buds obpyriform, calyx-divisions broadly ovate or triangular, terminating at the points in a tuft of ferrugineous hairs; outer petals linear-oblong, swollen at the base and concave within, sparsely rusty-pubescent on the outside; inner petals minute, pubescent on the back and bearing 2 rudimentary pollen-sacs; carpels distinct, glabrous near the base, rufous hirtellous above, at length growing together into a compound fr. or syncarpium: fr. large, conoid or broadly ovoid with an axis of about 6 in. and a diam. of 5 in., clothed with dense grayish felt-like tomentum and when mature usually bearing stout thick protuberances directed toward the apex, but these sometimes suppressed; pulp edible, cream-colored or rose-tinted; seeds hard, smooth and nutlike, golden brown or tan-colored. Mts. and foot-hills west coast of Mex. to Salvador.—The fr. is offered for sale in the markets of Colima and Acapulco. It is described by American Consul Marion Letcher, stationed at Acapulco, as shaped like a pineapple cheese, with delicious pink-tinted pulp; and Samuel E. Magill, American Consul at Guadalajara, states that the frs. grown on the side of the volcanos of Colima and Cerro Grande are of unusually fine quality. This species has been intro. into S. Fla.

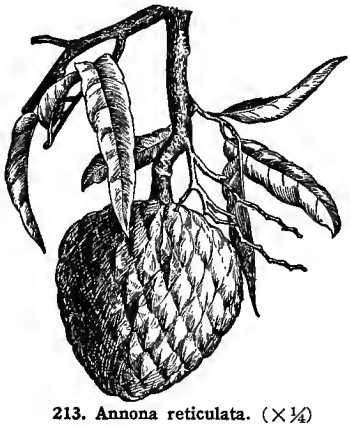
212. Annona diversifolia. (×¼)

BB. *Peduncles devoid of lf.-like bracts at the base.*

C. *Lvs. velvety beneath.*

6. **Cherimòla,** Mill. (*A. tripétala,* Ait.). CHIRIMOYA. CHERIMOYA. CHERIMOYER. CHERIMOLLA. Tree, 15–25 ft. high, with young growth fulvous tomentose: lvs. persistently velvety-tomentose beneath, sparsely pubescent above, ovate to ovate-lanceolate or obovate, sometimes elliptical, obtuse at the apex or obtusely acuminate, usually rounded at the base: fls. fragrant, extra-axillary, often opposite a lf. at the base of a branchlet, usually solitary but sometimes 2 or 3 on short nodding tomentose peduncles, the exterior petals oblong-linear, not exceeding 1¼ in. length, keeled on the inside and excavated at the base, greenish yellow or rufous on the outside and clothed with velvety tomentum, pale yellow or whitish within and marked with a purple spot at the base; inner petals very small, squa-

mose, ovate or triangular, usually flesh-colored or purple and keeled on the outside: fr. variable in shape and appearance, sometimes conoid or heart-shaped, with surface bearing protuberances; sometimes spheroid or ovoid with the surface covered with concave or squamose U-shaped areoles, each bearing a small wart or tubercle; and sometimes quite smooth or with the surface having the appearance of putty marked by fingerprints; pulp white, edible, pleasantly acidulous, easily separable from the seeds; seeds usually obovate, obliquely truncate, somewhat compressed, with a thin membranous brown testa which is usually more or less wrinkled or pitted, owing to the wrinkled surface of the inclosed endosperm. Andes of Peru and adjacent regions, but naturalized at a very early date in Mex. and Cent. Amer. Successfully intro. into S. Calif., Canary Isls., Madeira, the mts. of India, and Hawaii. Essentially a subtropical plant which does not yield good results in low tropical countries.—Frs. of exquisite flavor are produced on the island of Madeira, where the trees are trained on trellises and are taking the place of grapes in the economy of the island. Excellent results have also been secured in S. Calif. See *Cherimoya*.



213. Annona reticulata. (×¼)

7. **longifòlra,** Wats. Wild Cherimoya of Jalisco. A shrub or small tree, 3–10 ft. high; young growth softly pubescent: branches with prominent lf.-scars, which are clothed with a marginal collar of plush-like hairs: lvs. resembling those of *A. Cherimola* but distinguished when mature by being glabrate or glabrescent between the lateral nerves, which together with the midrib are persistently velvety pubescent, the blades 2–5½ in. long and 1½–3¼ in. broad, elliptical to obovate-elliptical, usually rounded but sometimes acute at the base and rounded at the apex, which is often minutely apiculate: fls. short-peduncled, pubescent, the calyx-divisions deltoid-ovate, clothed on the outside with fine soft hairs, the outer petals leathery, often 2 in. long, linear-oblong or oblong-lanceolate in shape, cream-colored or whitish, and marked within with a dark purple or blackish spot at the excavated base; inner petals minute (sometimes wanting), ovate, obtuse, finely pubescent; carpels distinct, the ovaries clothed with rufous hairs, and the styles minutely puberulent: fr. conoid or globose-ovate, its surface covered with protuberances or with reticulated areoles; pulp white, resembling that of *A. Cherimola* in flavor. State of Jalisco, Mex., especially in vicinity of Guadalajara and Tequila. Intro. into S. Calif., but as yet little known.

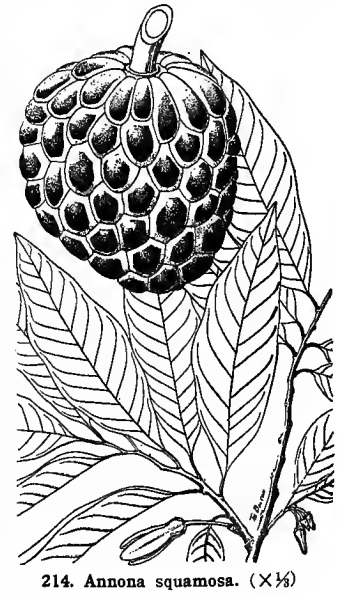
cc. *Lvs. not velvety.*

d. *Fr. smooth or nearly so, its surface divided into angular areoles by impressed lines; pulp tallow-like.*

8. **reticulàta,** Linn. (*A. longifòlia,* Mociño & Sessé). Common Custard-Apple. Bullock's-Heart. Corazon. Corossol Cœur-de-Bœuf. Coração de Boi. Mamon. Anonas. Anona Colorada. Quauhtzapotl. Fig. 213. A deciduous tree, 15–25 ft. high with young growth fulvous-pubescent, at length glabrate: lvs. approximate, oblong-lanceolate or lanceolate, acute at the apex, conduplicate, glabrate, or with the midrib and lateral nerves sparsely pubescent: fls. in extra-axillary clusters of several issuing from the new branchlets, peduncles nodding; outer petals fleshy, oblong-linear, keeled on the inside and excavated at the base, olive-green or yellowish, usually stained within with purple and with a dark purple blotch at the base; inner petals very small, scale-like, ovate, acute; carpels distinct, the ovaries covered with pale brown silky hairs, at length uniting to form a solid fr.: fr. 3–5 in. diam., smooth, with the surface divided into rhomboid or hexagonal areoles by impressed lines, usually reddish or reddish brown when ripe, or red-cheeked on the sunny side, pulp sweetish but insipid, tallow-like and usually granular, adhering closely to the seeds. Trop. Amer.; now widely spread throughout the tropics of both hemispheres.—A robust tree which has spread spontaneously in the forests of the Philippines, the island of Guam and the E. Indies, while its congeners, *A. muricata* and *A. squamosa*, occur usually only where planted. It is essentially tropical while the cherimoya, with the smooth-fruited forms of which it has often been confused, is subtropical. Its. fr. is inferior in flavor to both the cherimoya and the sugar-apple (*A. squamosa*), from the first of which it may be distinguished by its long, narrow, glabrate lvs., and from the second by its solid, compact fr., as well as its larger lvs. From *A. glabra*, with which it is also confused, it may be distinguished by its elongate narrow outer petals and its small, dark brown seeds. It is common in the W. Indies and thrives in S. Fla.

dd. *Fr. composed of rounded carpels loosely cohering when ripe, covered with a glaucous bloom; pulp creamy or custard-like.*

9. **squamòsa,** Linn. (*A. cinèrea,* Dunal. *A. Forskáhlii,* DC. *A. biflòra,* Mociño & Sessé). Sugar-Apple. Sweet-Sop. Anon. Atta. Atte. Atis. Pomme-Cannelle. Keschta. Fruta da Condessa. Ahate de Panuco. Steenappel. Texaltzapotl. Pinha. Fig. 214. A small deciduous tree, 15–20 ft. high, with irregularly spreading branches and zigzag branchlets bearing approximate 2-ranked lvs.; young growth pubescent, at length glabrate or clothed with scattered hairs and dotted with lenticels: lvs. conduplicate, resembling those of *A. reticulata*, but smaller, usually lanceolate or oblong-lanceolate, acute or shortly acuminate at the apex and acute or cuneate at the base, sometimes ovate or elliptical and rounded at the base with a tendency to be asymmetrical, membranaceous, minutely punctate with both surfaces pale green; sparsely hairy at first, at length glabrate or nearly so, except the petiole, which is pubescent: fls. borne on the young branchlets, closely resembling those of *A. reticulata*, extra-axillary, usually in clusters of 2, 3, or 4, but sometimes solitary; peduncles slender, sparsely and delicately pilose, at length glabrate, bearing a minute bracteole below the middle, which terminates in a tuft of floccose hairs; outer petals oblong-linear, thick, triquetrous, rounded at the apex and



214. Annona squamosa. (×⅓)

excavated at the base, greenish yellow, usually marked within by a wine-colored or purplish red spot at the base; inner petals minute, ovate or obovate, keeled on the outside; stamens with broad terminal connectives of a cinnamon-brown or orange-red color; carpels distinct, clothed with pale brown hairs, sulcate on the ventral side and terminating in oblong or taper-pointed styles: fr. about the size of an orange, spheroid or heart-shaped, composed of loosely cohering carpels rounded at the extremities and grooved on the inner side, forming a squamose or tuberculated surface, greenish yellow and covered with a glaucous bloom at first, but soon turning black in spots when handled, and the waxy bloom easily rubbed off; pulp yellowish white, creamy or custard-like, very sweet and pleasantly flavored; seeds dark brown, smooth, closely resembling those of *A. reticulata.* Trop. Amer., now widely cult. in all tropical countries.—Less robust than *A. reticulata,* with fr. much more highly prized, and produced several times during the year instead of only once, as in that species. Like *A. reticulata,* it is essentially tropical and will not thrive in subtropical regions which are suitable for the cult. of the cherimoya. It has been intro. into S. Fla. Delicious sherbets are made from its custard-like pulp, often with the addition of a little lemon juice, but it is never cooked or made into preserves or jelly, like the soursop. The fr., when green, as well as the seeds and lvs., is used for destroying vermin; and the crushed lvs., in the form of poultices, are applied to ulcers and malignant sores in the W. Indies. The root is a drastic purgative.

W. E. Safford.

ANNUALS. What are known to gardeners as "annuals" are plants that bloom in the open the same year the seeds are sown and that do not live over winter.

These plants are not necessarily true annuals; for annuals in the botanical sense are plants that normally complete their entire life-cycle within one vegetation-year. Perennial plants that bloom freely from seed the first year and do not usefully survive till another year may be classed as annuals by the gardener and treated as such: these are properly plur-annuals, a group standing midway between annuals and perennials. The garden *Nicotiana affinis* (properly *N. alata*) and pinks and snapdragons are such. It may be said that plur-annuals are plants of somewhat indefinite duration that are terminated by cold weather rather than by their normal maturity within the season. Many real perennials, as castor bean, are treated as annuals in northern gardens.

Some of the biennial plants—those that normally bloom and perish in the second year—may flower the first year if the seeds are sown early and the plants are hurried along. Of these, Canterbury bell, ipomopsis and some of the œnotheras are examples. See *Biennials.*

The annuals of gardens are grown directly from seeds, in usual practice. Some plants are reared annually from bulbs or tubers, as crocus, lilies, potato: these are really perennials that die each year to the ground and do not perish root and branch. To these plants the name pseud-annuals (i.e., false annuals) has been given.

Among the true annuals there are many grades. Some of them are winter annuals, growing in the cool part of the year and carrying over winter under the snow, as the common creeping chickweed and other crucifers. In the arid regions of the West, many annual plants spring into growth with the rains and thrive in the cool months. Many of the annuals are summer annuals and others are autumn annuals: these two classes are practically the only ones that are cultivated in the open for ornament.

Among the annuals are found some of the most showy garden flowers. As a rule, they are easily grown, producing quick results and affording a great variety of colors, forms and foliage. Some of the annuals last only a few weeks in bloom, others continue throughout the summer. There are trailers and climbers, dwarfs and tall growers. By a judicious selection and arrangement of kinds, the handsomest effect may be produced. Many of the showy kinds are adapted to mass effects, while the dwarf-growing sorts make good flowering edgings for beds or walks. With the latter, handsome ribbon-beds are possible, but this requires care in the selection of kinds, and as the use of the trimming shears is almost precluded, it is best to limit oneself to simple designs. Annuals are well suited to the covering of bare spots of ground in the border. Like other flowers, they display best when seen against a background of foliage. The tall and leafy kinds make excellent covers for unsightly objects. For climbing and twining kinds, see *Vines.* See, also, *Everlastings* and *Grasses.*

Classification as to hardiness.

It is customary to divide annuals into three classes: (1) Hardy annuals are those that are sown directly in the open ground where they are to grow. They are

215. Annuals filling the formal space between a drive and a tree-group.

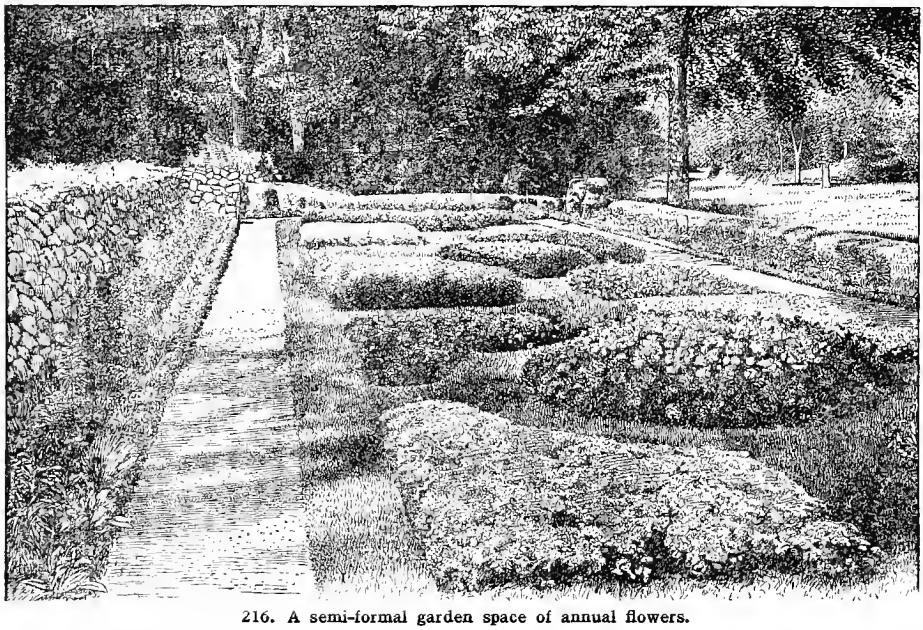
vitally strong, developing without artificial heat, and may be sown from February to May, according to the season and latitude. Some of them, as sweet peas, may be sown even in the fall. For this class, a well-prepared border on the south side of a fence or wall, or other sheltered place, is usually preferred for early sowings. From here the seedlings are transplanted later where they are to grow. Some sorts, however, do not bear transplanting well, consequently must be sown in the places they are to occupy. Among such are poppies, eschscholtzia, bartonia, Venus' looking-glass, lupine, malope, and the dwarf convolvulus. (2) Half-hardy annuals are usually sown in February or March in the window or a warm frame. The season is usually not long enough to enable them to reach full development in the open. In the early stages of growth they need protection and warmth. Such kinds are sometimes sown in the fall and wintered over in a coldframe. When once established, they are hardy with slight protection. Some of the kinds are grown to their greatest perfection only in this way. (3) Tender annuals require still more warmth, and are started from January to May in the greenhouse or other suitable place. They commonly need a temperature of 60° to 70°. The danger with early-grown seedlings, especially those started in the window, is over-crowding and want of light. As soon as crowding begins, the plants should be

thinned out or transplanted to other trays, or into pots, and reset from time to time, as they need; frequent transplanting is usually an advantage. The last transplanting is preferably into small pots, as then the seedlings may be readily set in the open ground at the proper time, with little or no check.

Seed-sowing.

The greater number of common annuals will bloom freely if the seeds are sown in the open ground when the weather becomes thoroughly settled. But there are some kinds, as the late cosmos and moonflowers, for which the northern season is commonly too short to give good bloom unless they are started very early indoors.

In the case of others than the continuous bloomers, a succession of sowings or plantings is desirable to provide for a continuous display; then as a kind begins to fail, its place may be filled with young plants of the same or other species. The usual method of securing succession is to sow the seeds in flats, or beds, and transplant the seedlings first to pots. The potted plants may be set out at any time, with but little check to growth.



216. A semi-formal garden space of annual flowers.

When flowers of any annual are wanted extra early, the seeds should be started indoors. It is not necessary to have a greenhouse for this purpose, although best results are to be expected with such a building. The seed may be sown in boxes, and these boxes then placed in a sheltered position on the warm side of a building. At night they may be covered with boards or matting. In very cold "spells" the boxes should be brought inside. In this simple way seeds may often be started one to three weeks ahead of the time when they can be sown in the open garden. Moreover, the plants are likely to receive better care in these boxes, and therefore to grow more rapidly. Of course, if still earlier results are desired, the seed should be sown in the kitchen, hotbed, coldframe, or in a greenhouse. In starting plants ahead of the season, be careful not to use too deep boxes. The gardener's "flat" may be taken as a suggestion. Three inches of earth is sufficient, and in some cases (as when the plants are started late) half this depth is enough.

One trouble with early sown seedlings is "drawing up," and weakness from crowding and want of light. This is most likely to occur with window-grown plants. Vigorous June-sown plants are better than such weaklings. It must be remembered, however, that very early bloom usually means the shortening of the season at the other end; this may be remedied to some extent by making sowings at different times.

Only the best seeds should be purchased, and it is usually best to get the colors in separate packets. In the open ground, seeds may be covered to a depth of four or five times their own thickness, but when sown indoors in trays or pots, the rule is to cover them to about their own thickness. After covering, the soil should be pressed firmly over the seed with a board or hoe, or the feet. In soils that are inclined to bake, a sprinkling of sand or fine litter over the surface after sowing will remedy this evil. Evergreen boughs placed over the beds until the seedlings have appeared will afford useful shelter from beating rains. It is desirable to sow the seeds thickly. For the reception of seeds, the surface should be mellow and smooth. The seeds are sown in drills or concentric circles, according to the method of planting decided upon. Taller-growing kinds are sown toward the center or back of the bed. When up, the plants may be thinned to their proper distances. Particular care should be given to this matter, and to keeping down weeds, or the plants may become weak, spindling and valueless. Much trouble will be avoided if each seed-row is plainly labeled or marked so that the young plants may be distinguished from the weeds, with which they must often compete.

Soils and places.

Most annuals thrive best in an open, sunny situation, but pansies, forget-me-nots, and some others, thrive where they get the full sunshine for only half the day. Some of the kinds are at their best in full sunlight, as portulaca, sunflower, and zinnia. In all cases the best results are secured only when the soil is well enriched and thoroughly prepared previous to sowing or planting; and it is far better to make this preparation a fortnight or more in advance. A considerable proportion of humus in the soil is desirable, rendering it less subject to baking and drying out. Cow-manure, stable-manure or leaf-mold, worked in liberally, will supply this. Beds should be spaded thoroughly and at least a foot deep. If the surface is then again worked over to half this depth, better results will be obtainable. The soil should not be disturbed, however, unless it pulverizes readily.

When the flowers are to be grown about the edges of the lawn, make sure that the grass roots do not run underneath them and rob them of food and moisture. It is well to run a sharp spade deep into the ground about the edges of the bed every two or three weeks for the purpose of cutting off any grass roots that may have

run into the bed. If beds are made in the turf, see that they are 3 feet or more wide, so that the grass roots will not undermine them. Against the shrub borders, this precaution may not be necessary: it is desirable that the flowers fill all the space between the overhanging branches and the sod.

The plants should not be allowed to bear seed, else they will be exhausted and the season of bloom will be short. Sweet peas, for example, soon spend themselves and dry up if the pods are allowed to ripen. The frequent cutting of blooms prolongs the season.

The kinds.

Most of the staple or general-purpose types of annuals in the North are the following: petunias, phloxes, pinks or dianthuses, larkspurs or delphiniums, calliopsis or coreopsis, pot marigolds or calendulas, bachelor's buttons or *Centaurea Cyanus*, clarkias, zinnias, marigolds or tagetes, collinsias, gilias, California poppies or eschscholtzias, verbenas, poppies, China asters, sweet peas, nemophilas, portulacas, silenes, candytufts or iberis, alyssum, stocks or matthiolas, morning-glories, nasturtiums or tropæolums, wallflowers, gaillardias, snapdragons, coxcombs, lobelias, four-o'clocks, amaranths, balsams, sweet sultans, salpiglossis, scabiosas, nicotianas, and pansies. Other species are mostly of special or particular use, not general-use types. In the South, and occasionally at the North, some of the annuals come up voluntarily year after year from self-sown seeds, e. g., petunias, phloxes and morning-glories.

Late sowings, even as late as June in the latitude of New York City, may be made of such things as China aster, sweet alyssum, California poppy (Eschscholtzia), calliopsis or coreopsis, portulaca, calendula, phlox, zinnia, marigold, candytuft, mignonette, petunia. Late-blooming beds of these and other annuals may be secured by this delayed sowing. The tendency to sow everything for early bloom deprives the garden of much freshness and interest in autumn.

The numbers of varieties in some of these long-cultivated species-groups are surprising large, and they often appeal to collectors. If a collector desires annuals for autumn display, for example, he will find that zinnias have about forty current varieties, annual pinks about fifty, petunias about sixty, pansies sixty to seventy, balsams over sixty, and stocks perhaps 300, all of which may be prolonged more or less into autumn. But the most appropriate and varied of these annuals are the China asters, which have about 450 varieties. Owing to the greater variety of everything abroad, collectors naturally send to Europe for large collections, and the very low duty on flower seeds has stimulated the collecting of annuals. Perennial flowers are more difficult to import, but many persons have recently imported fifty or more varieties of the following: gaillardia about 100 varieties, hardy chrysanthemums 100 and more, florists' pentstemons more than 150 (not sufficiently hardy), delphiniums over 200, and phlox 350. Unfortunately, collections of a single flower rarely give an artistic effect, even when at their best, owing to the difficulty of isolating troublesome colors in a garden that must be sunny, failures among highly bred varieties, the fact that the early, midseason and late sections mix poorly, and so on. The obvious limitation of gardens devoted to one kind of flower is that they are unattractive out of season, and therefore it is best to isolate them. There are practically no annuals that bloom satisfactorily throughout summer and autumn.

Background plants, for bold mass-displays of color in the rear parts of the grounds or along the borders may be secured from some of the coarser species. Good plants for such use are: sunflower and castor-bean for the back rows; zinnias for bright effects in the scarlets and lilacs; African marigolds for brilliant yellows; nicotianas for whites. Unfortunately, we have no robust-growing annuals with good blues. Some of the larkspurs and the browallias are perhaps the nearest approach to them.

For lower-growing and less prominent mass-displays, the following are good: California poppies for oranges and yellows; sweet sultans for purples, whites, and pale yellows; petunias for purples, violets, and whites; larkspurs for blues and violets; bachelor's buttons (or cornflowers) for blues; calliopsis and coreopsis and calendulas for yellows; gaillardias for red-yellows and orange-reds; China asters for many colors except yellows.

For still less robustness, good mass-displays can be made with the following: alyssums and candytufts for whites; phloxes for whites and various pinks and reds; lobelias and browallias for blues; pinks for whites and various shades of pink; stocks for whites and reds; wallflowers for brown-yellows; verbenas for many colors.

Vines are abundant among the annuals, the most prominent being morning-glory, sweet pea, cobea, climbing nasturtium, Japanese hop, cypress-vine and other ipomœas, balloon-vine, scarlet-runner, moonflowers in the South.

Some of the "everlastings" or immortelles are useful as flower-garden subjects as well as for "dry-bouquets." These "paper flowers" are always interesting to children. The colors are bright, the blooms hold long on the plant, and most of the kinds are very easy to grow. Favorite groups are the different kinds of xeranthemums and helichrysums. The globe amaranths, with clover-like heads (sometimes known as bachelor's buttons), are good old favorites. Rhodanthes and acrocliniums are also good and reliable.

Ornamental grasses should not be overlooked. They add a note to the flower-garden and to bouquets that is distinct and can be secured by no other plants. They are easily grown. Some of the good annual grasses are *Agrostis nebulosa*, the brizas, *Bromus brizæformis*, the species of eragrostis, and pennisetums and *Coix Lachryma* as a curiosity. Such good lawn grasses as arundo, pampas-grass, eulalias, and erianthus are perennials and therefore are not discussed here.

The amateur would do well to make up lists from the most detailed seed catalogues. The following short lists (under trade names) suggest a few things in several categories:

White-flowered annuals.

Ageratum mexicanum album.
Alyssum, common sweet.
Centranthus macrosiphon alhus.
China asters.
Convolvulus major.
Dianthus, Double White Margaret.
Iberis amara; coronaria.
Ipomœa hederacea.
Lavatera alba.
Malope grandiflora alha.
Matthiola (Stocks), Cut-and-Come-Again; Dresden Perpetual; Giant Perfection; White Pearl.
Mirabilis longiflora alha.
Nigella.
Phlox, Dwarf Snowhall; Leopoldii.
Poppies, Flag of Truce; Shirley; The Mikado.
Zinnia.

Yellow- and orange-flowered annuals.

Cacalia lutea.
Calendula officinalis, common; Meteor; sulphurea; suffruticosa.
Calliopsis bicolor marmorata; cardaminifolia; elegans.
Cosmidium Burridgeanum.
Dimorphotheca aurantiaca.
Erysimum Perofskianum.
Eschscholtzia californica.
Hibiscus africanus; Golden Bowl.
Ipomœa coccinea lutea.
Loasa tricolor.
Tagetes, various kinds.
Thunbergia alata Fryeri; aurantiaca.
Tropæolum, Dwarf; Lady Bird; Tall, Schulzii.
Zinnia.

Blue- and purple-flowered annuals.

Ageratum mexicanum; mexicanum Dwarf.
Browallia Czerniakowski; elata.
Centaurea Cyanus, Victoria Dwarf Compact; Cyanus minor.
China asters of several varieties.
Convolvulus minor; minor unicaulis.
Gilia achilleæfolia; capitata.
Iberis umbellata; umbellata lilacina.
Kaulfussia amelloides; atroviolacea.
Lobelia Erinus.
Nigella.
Phlox variabilis atropurpurea.
Salvia farinacea.
Specularia.
Verbena, Black-Blue; cærulea; Golden-leaved.
Whitlavia gloxinioides.

Rose- and rose-red-flowered annuals.

Cacalia, Scarlet.
Clarkia elegans rosea.
Convolvulus tricolor roseus.
Dianthus, Half-Dwarf Early Margaret; Dwarf Perpetual chinensis.
Gaillardia picta.
Ipomœa coccinea; volubilis.
Matthiola annuus; Blood-Red Ten Weeks; grandiflora, Dwarf
Papaver (Poppy) cardinale; Mephisto.
Phaseolus multiflorus.
Phlox, Large-flowering Dwarf; Dwarf Fire-ball; Black Warrior.
Salvia coccinea.
Saponaria. [Thumb.
Tropæolum, Dwarf, Tom
Verbena hybrida, Scarlet Defiance.
Ziunia.

Annuals useful for edgings of beds and walks, and for ribbon-beds.

Ageratum, blue and white
Alyssum, sweet.
Brachycome.
Calandrinia.
Clarkia.
Collinsias.
Dianthuses or pinks.
Gilia.
Gypsophila muralis.
Iberis or candytufts.
Leptosiphons.
Lobelia Erinus.
Nemophilas.
Nigellas.
Portulacas or rose moss.
Saponaria calabrica.
Specularia.
Torenia.
Whitlavia.

Late-blooming annuals.

Probably the best annuals to bloom in late fall, even after the first frosts, are petunia, phlox, and verbena. Other excellent kinds are ageratum, alyssum, antirrhinum or snapdragon, *Calendula officinalis*, California poppy, gaillardia, marigold, and pansy. The list may be extended by

Abronia umbellata.
Adonis æstivalis; autumnale.
Argemone grandiflora.
Callirhoë.
Carduus benedictus.
Centaurea Cyanus (bachelor's button).
Centauridium.
Centranthus macrosiphon.
Cerinthe retorta.
Cheiranthus Cheiri.
Chrysanthemums.
Convolvulus minor; tricolor.
Dianthus of various kinds.
Elsholtzia cristata.
Erysimum Perofskianum; arkansanum.
Gilia achilleæfolia; capitata; laciniata; tricolor.
Iberis affinis.
Lavatera alba.
Matthiolas or stocks.
Œnothera rosea; Lamarckiana; Drummondii.
Podolepis affinis; chrysantha.
Salvia coccinea; farinacea; Horminum.
Vicia Gerardii.
Virginian stocks.
Viscaria elegans; oculata; Cœlirosa.

If sown early or in the fall, bachelor's button, annual gypsophila and poppy will re-seed and furnish plants for late fall bloom.

L. H. B.†

ANŒCTOCHÌLUS (Greek, *open lip*). *Orchidàceæ*. A group cultivated for the beautifully reticulated leaves, which are oval or ovate, membranaceous and diversely colored; the flowers are small, not ornamental.

Terrestrial, from a creeping rhizome: lvs. basal: fls. in a spike or raceme; sepals free, the dorsal erect, forming a hood with the petals, the lateral sepals spreading; lip adnate to the foot of the column, spreading; claw fimbriate, the blade 2-lobed.—About 8 species.

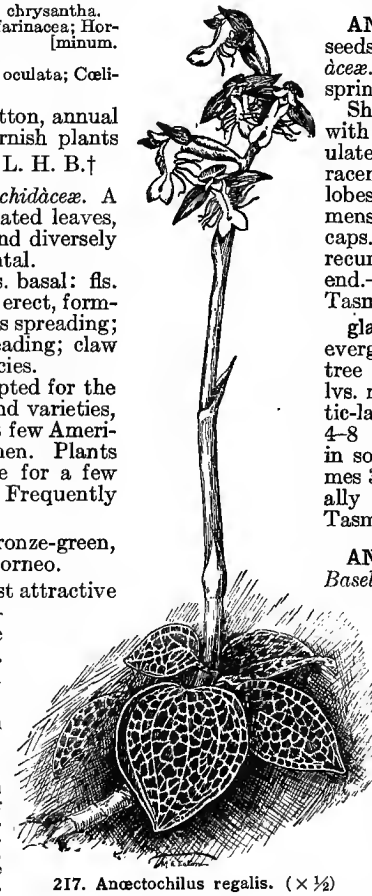
Although many methods have been adopted for the successful cultivation of the best species and varieties, failure has been the rule, so that at present few American collections contain even a single specimen. Plants introduced by collectors sometimes thrive for a few years and then fail, in spite of all efforts. Frequently they can be kept only a year or two.

Búllenii, Low. Lvs. about 2 in. long, bronze-green, with 3 longitudinal bands of copper-red. Borneo.

regàlis, Blume. Fig. 217. One of the most attractive species of the group: lvs. oval, large, bronze-green netted, veined with gold, the surface of the lvs. like velvet. Java. B.M. 4123. F.S. 2:79 (both as *A. setaceus*).—Several good varieties exist.

Róxburghii, Lindl. Lvs. ovate, median line of pale green, reticulated and veined with gold. Java and India.

Several kinds are described and figured in foreign publications, but they are all fanciers' plants. Other names which appear in the American trade are: *A. Dayàna* = (?) — *A. Dawsoniànus* = Hæmaria.—*A. Fréderici-Àugustii*, Reichb. f. (*A. xanthophyllus*, Planch.). Lvs. dark velvety green, the broad orange stripe down the center covered with a network of gold.



217. Anœctochilus regalis. (× ½)

G. 10:675; 27:54.—*A. Lòwii*, Hort.=Dossinia.—*A. Petòla*, Hort.=Macodes.—*A. Veitchiànus*, Hort.=Macodes.

GEORGE V. NASH.†

ANOGRÁMMA (Greek, *without lines* referring probably to the absence of indusia). *Polypodiàceæ*. A small group of tropical ferns, somewhat related to Pteris, and characterized by linear sori uncovered by indusia. The lvs. are borne in a cluster, are small, 1–2 pinnate with pinnatifid divisions and forking veinlets.

schizophýlla, Diels. (*Gymnográmma schizophýlla*, Baker). Lvs. 18–24 in. long, quadri-pinnatifid, the stalks, rachises and divisions slender, the ultimate segms. finely cut. A comparatively recent intro.; very graceful in cult. Jamaica. A.G. 18:421. G.F. 2:533. A.F. 10:827. I.H. 31:522. Gn. 48, p. 417. Var. **elegantíssima** (*Gymnográmma elegantíssima*, Hort. W. Bull.), has reddish brown rachises.

R. C. BENEDICT.

ANOIGÁNTHUS (from Greek words, alluding to the expanded flower). *Amaryllidàceæ*. A small probably monotypic genus of Natal and the Cape region, the plants sometimes cult. as greenhouse winter- and spring-flowering bulbs. **A. breviflòrus,** Baker (*Cyrtánthus breviflòrus*, Harv.), has an ovoid bulb 1 in. diam., with a short neck: lvs. 3–4, appearing with the fls., 1 ft. or more: fl.-st. to 1 ft. high, bearing a 2–10-fld. umbel: fls. bright yellow, about 1 in. long, with a short tube and oblong-lanceolate nearly equal segms; stamens 6, in 2 series: fr. a globose membranous caps., 3-valved; seeds flat. B.M. 7072. Var. **minor,** Baker (*A. lùteus*, Baker), is a dwarf mountain form with narrower perianth-segms. These plants are half-hardy in the milder parts if given good protection over winter.

ANOMATHÈCA: *Lapeyrousia.*

ANÓPTERUS (referring to the seeds being winged at top). *Saxifragàceæ*. Greenhouse shrub, blooming in spring.

Shrubs or small trees, glabrous, with alternate thick evergreen exstipulate lvs., and white fls. in terminal racemes: calyx-tube very short, the lobes 6–9, persistent; petals and stamens as many as calyx-lobes: fr. a caps., oblong-conical, opening by 2 recurved valves; seeds winged at one end.—Two species in Australia and Tasmania.

glandulòsus, Labill. Handsome evergreen shrub, becoming a small tree (to 40 ft.) in its native regions: lvs. mostly at ends of branches, elliptic-lanceolate to somewhat obovate, 4–8 in. long, somewhat serrate: fls. in somewhat drooping bracted racemes 3–6 in. long; parts of petals usually 6, about ½in. long. Subalpine Tasmania.

L. H. B.

ANREDÈRA (personal name). *Basellàceæ*. A monotypic genus, allied to Boussingaultia. Vine, with fleshy sts. and lvs., tuberous-rooted: fls. small, white, in long slender mostly axillary spikes; sepals 2, broadly winged; petals 5, not exceeding sepals; stamens 5, the filaments fattened; stigma entire. **A. scándens,** Moq., is native Texas to S. Amer., and planted in Old World tropics, a much-branched vine sometimes cult. in greenhouses, with lvs. ovate and more or less acute, entire.

ANSÉLLIA (in honor of John Ansell, African explorer). *Orchidàceæ*. Epiphytic hothouse orchids with tall, thickened leafy stems.

Flowers in panicles, showy; sepals and petals similar, spreading; lip erect, sessile at the end of the column-foot; lateral lobes broad, parallel, erect; middle lobe round-ovate, spreading; pollinia 2.—A genus of 4 closely related species, perhaps all forms of 1 species.

africàna, Lindl. Sts. up to 2 ft. tall, leafy above: lvs. 4–8 in. long, about 5-nerved, elongated-lanceolate: panicle many-fld.; fls. 2 in. across, with brown-purple spots on a light yellow-green background; sepals narrow-oblong; petals about twice as broad as sepals; lateral lobes of lip oblong, the middle lobe ovate. Fernando Po. B.M. 4965.

gigantèa, Reichb. (*Cymbídium Sándersonii,* Harv.). Differs from the above in the smaller fls. with narrower segms. which are spotted on the lower part only. Natal. B.M. 4965, f. 3.

GEORGE V. NASH. †

ANSÒNIA: *Amsonia.*

ANTENNÀRIA (pappus likened to antennæ). *Compósitæ.* EVERLASTING. CAT'S-EAR. LADIES' TOBACCO. PUSSY'S TOES. Field herbs, sometimes offered by dealers in native plants.

Small, white-woolly perennial plants, with spatulate or obovate root-lvs., and mostly leafless scapes, bearing small gray or white heads which remain stiff and dry: fls. dicœcious, the staminate forms rare in cult., all tubular.—None is showy. They are interesting for rock-work and the edges of borders, and for this purpose have been sparingly intro. in the last few years. They are perfectly hardy, and thrive in poor soil. The fls. are often cut before fully mature and dried (and often dyed) as everlastings. About 20 species grow wild. Prop. mostly by division of the mats; also by seeds. Allied to Anaphalis and Gnaphalium, both of which are leafy stemmed plants quite distinct from the prostrate, stemless antennarias, which send up only a bracted scape, except in *A. racemosa.* See *Everlastings.*

A. *Pappus of sterile fls. not thickened at the tip, minutely roughened.*

dimórpha, Torr. & Gray. Tufted, with spatulate lvs. and a sparsely lvd. fl.-st. an inch or less high, from a stout, much-branched rootstalk. Neb. west to Calif.

AA. *Pappus of sterile fls. thickened at the top.*

B. *Not spreading by stolons.*

Geyèri, Gray. Stout, thick-woolly, from a woody base: fls.-st. 3 in. or more high, very leafy to the top: pistillate heads narrow: involucre with rose-purple or ivory-white tips to the inner scales. Calif. and Ore.

BB. *Spreading by stolons.*

C. *Heads solitary or in a cymose cluster.*

dioìca, Linn. (*A. cándida,* Hort.). Basal lvs. 1½ in. or less long, 1-nerved or only indistinctly 3-nerved: st. 2–12 in.: involucral bracts all light green or light brown, with white or pinkish tips. Northern states and Eu., and Asia.—The plant in the trade as *A. tomentosum* is probably a form of this species. Also in cult. under the proper name, *A. dioica. A. hyperborea,* Hort., a name common in the trade, is apparently a mere form of this with pinkish fls.

alpìna, Gaertn. Plant 1–4 in.: involucral bracts in fertile heads, dark brownish green, acute. Canada, Rocky Mts., Sierra Nevadas.

plantaginifòlia, Rich. Basal lvs. 1½ in. or more long, distinctly 3-nerved: st. 6–18 in. high.—Stoloniferous, making broad patches. Common in fields and old pastures. Perhaps not in cult.

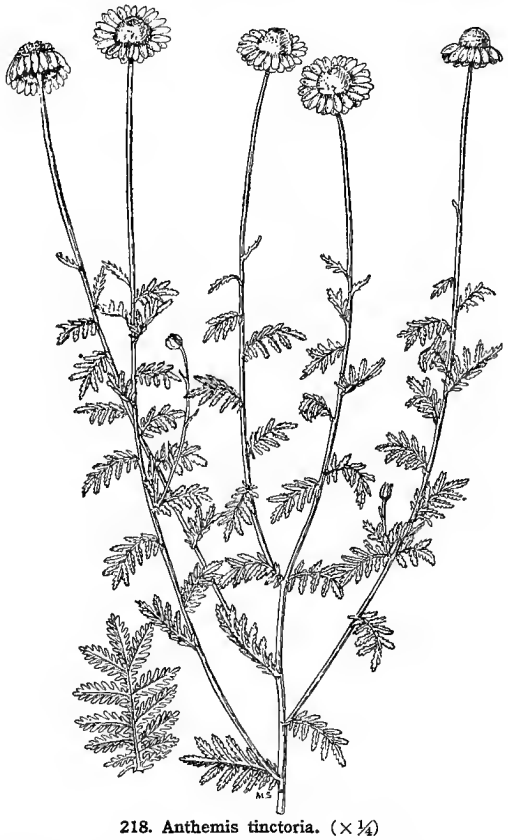
CC. *Heads loosely panicled.*

racemòsa, Hook. Light-woolly, the flowering sts. 6–20 in. high, sparsely leafy, the heads mostly on slender peduncles: involucre brownish, white-tipped. Ore. and Brit. Col. to the Rockies.

A. margaritàcea=Anaphalis margaritacea.

N. TAYLOR.†

ÁNTHEMIS (Greek name of the chamomile). *Compósitæ.* CHAMOMILE. Pyrethrum-like heavy-scented plants, annual, biennial or perennial, members of a large, Old World temperate-region genus, used in borders and alpine gardens.



218. Anthemis tinctoria. (×¼)

Heads many-fld., the disk yellow, the rays white and yellow and (in the common cult. species) pistillate, the receptacle conical and chaffy, the achenes terete or ribbed, and either naked or bearing a minute crown: lvs. pinnately dissected.

Two or three of the species are weeds. Others are excellent border plants. The true chamomile is a medicinal plant. The hardy perennial species, which alone are grown in this country, are easily handled in the border, where they bloom from midsummer till frost. They thrive in almost any soil, but need full exposure to sun.

Propagation is by seeds or division of the clumps, usually the latter.

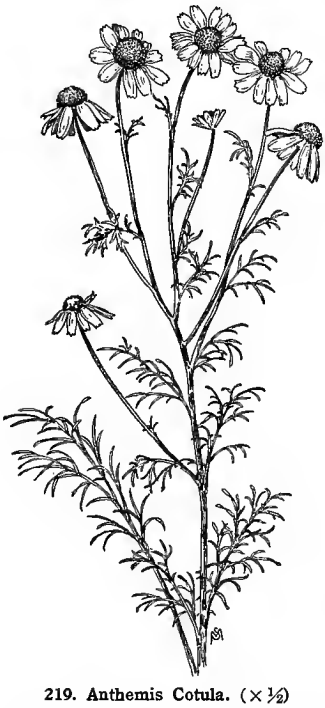
A. *Rays normally yellow.*

tinctòria, Linn. GOLDEN MARGUERITE. Fig. 218. Of bushy habit, 2–3 ft., with angular st. and pinnately divided, and again pinnatifid or cut-toothed lvs., and large, daisy-like golden yellow fls. (1–2 in. across). Gn. 42, p. 91; V. 18:33. *A. Kélwayi,* Hort. (or var. *Kélwayi,* Hort.), has finer-cut foliage and deeper yellow fls. There is also a pale-rayed variety and a white-fld. form is sold under the name *A. montàna.* Gn. 52:484. —An excellent hardy perennial border plant, and useful at the same time for cut-fls.

AA. *Rays white.*

B. *Perennial; cult.*

nóbilis, Linn. CHAMOMILE. Half-spreading and much-branched herb, downy, the lvs. very finely dissected: pappus wanting, chaff of the receptacle blunt. Var. **grandiflòra,** Hort., is larger-fld. than the type, and sometimes yellow-fld.—A pleasant-scented herb, sometimes escaped from cult. It yields the medicinal chamomile fls. of commerce. For medicinal purposes, the heads (the single preferred) are cut as soon as fully expanded, and dried. Cult. also as a hardy border plant; often double.



219. Anthemis Cotula. (×½)

BB. *Biennial or annual; weeds.*

arvénsis, Linn. Pubescent, not ill-scented: lvs. rather coarsely 1–2 pinnately parted: pappus a minute border: heads 1 in. or more across; the involucre with broad, blunt scarious marginal edges; rays pistillate, spreading, 2-toothed.—Not common and rather coarse.

Cótula, DC. MAYWEED. DOG FENNEL. Fig. 219. A common weed along roadsides, ill-scented, growing 1–2 ft. high, with finely dissected lvs., neutral rays and many aster-like fls. 1 in. across.

A. Aizoon, Griseb.=Achillea ageratifolia. Gn. 24:342.—*A. arábica,* Linn.=Cladanthus.—*A. coronària,* Hort.=Chrysanthemum coronarium.—*A. floribúnda,* Hort. Dwarf: lvs. much dissected: fl.-heads pure white.—*A. Biebersteiniàna,* Koch, is found in some catalogues. It is an alpine plant with pinnate lvs., which are silvery, and yellow fls. Can be cult. only in the alpine garden.

L. H. B.
N. TAYLOR.†

ANTHER: *Flower.*

ANTHÉRICUM (Greek, *flower hedge*). Includes *Phalangium. Liliàceæ.* Non-bulbous liliaceous plants grown in borders and cool greenhouses.

Herbs, with tuber-like rhizomes, and racemes of rather small, white, deep-cut fls.: perianth rotate; anthers attached between their basal lobes, and the locules many-ovuled—in these characters differing from Paradisea.—Some 50 species, mostly African, but a few in the western hemisphere.

The anthericums are useful for lawn vases, for borders that are protected in winter at the North, for greenhouses and also for growing under benches. Propagation naturally by stolons; increased also by division and seeds. Of easiest culture. Give plenty of water when in bloom.

Liliàgo, Linn. ST. BERNARD'S LILY. Figs. 220, 221. St. simple, 2–3 ft. high, bearing an open raceme of open-spreading fls. 1 in. or less across, the segms. linear-oblong: lvs. long and narrow. S. Eu. and N. Afr. B.M. 914. Var. **màjor,** Sims, is larger in all its parts. B.M. 1635.

ramòsum, Linn. St. branched: fls. somewhat smaller. Eu. B.M. 1055.

A. Bichétii, Hort. Lvs. flexible, variegated with white; elegant habit. W. Trop. Afr.—*A. califórnicum,* Hort.=Chlorogalum pomeridianum.—*A. Hóffmannii,* Engler. Free-flowering: lvs. 1 ft., 1¾ in. broad, shining green: fls.-sts. scarcely exceeding the lvs.: fls. in dense panicles, star-shaped, white. E. Afr.—*A. Liliástrum,* Linn.=Paradisea Liliastrum.—*A. picturàtum, A. variegàtum* and *A. vittàtum* are garden names for Chlorophytum elatum.

L. H. B.

ANTHOLÝZA (name from the Greek, referring to fancied shape of flower). *Iridàceæ.* Cormous plants of the gladiolus kind, grown in the open for summer bloom; red and yellow.

Perianth long-tubular, curved, dilated above, the uppermost segms. largest; stamens 3; style branched; ovary 3-loculed.—About 14 or more Cape and Trop. African plants, with linear or sword-shaped lvs. and bright fls. in 2-sided spikes. Cult. the same as gladioli, being taken up in the fall. The tubers are often started in a frame or in the house before planting in the open.

A. *Perianth red; segms. very unequal.*

Cunònia, Linn. Corm small, globose: st. simple, 1–1½ ft.: lvs. about 4, linear, 1 ft. or less long: fls. 4–6, in a lax spike, bright red, tube an inch long, the stamens reaching to the tip of the upper segm: seeds discoid, winged. Cape. L.B.C. 20:1971 (as Anisanthes).

cáffra, Ker. Corm large, globose, long-necked: st. 2 ft. or less: lvs. narrow-linear, 1 ft.: fls. 12–20, in a lax spike, bright red, tube 1–1¼ in. long, stamens not quite reaching tip of upper segm.: seeds 3-angled, narrowly winged. Cape.—Has been hybridized with gladiolus.

AA. *Perianth red and yellow; segms. less unequal.*

æthiòpica, Linn. (*A. ringens,* Andr.). Corm large, globose: st. branched, 3–4 ft.: lvs. several, sword-shaped, 1 in. broad and 1–1½ ft. long: spikes 6–9 in. long, rather dense; fls. 1½–2 in. long, red-yellow; stamens reaching to the tip of the upper segm.: seeds turgid, not winged. Cape. B.M. 561. Var. **mìnor,** Lindl. (*A. bicolor,* Gasp.). Dwarf: lvs. narrow: fls. red at top, pale yellow below. B.R. 1159. Var. **vittígera,** Baker, (var. *ringens,* Nichols.). Tall as the type: fls. bright yellow, striped red. B.M. 1172. Var. **immarginàta,** Baker. Fls. red, with dull yellow.

paniculàta, Klatt. Corm large, globose: st. stout, much branched, 3–4 ft.: lvs. lanceolate, oblique, 2 ft. or less long, to 3 in. broad: spikes dense, many-fld., with wavy rachis; fls. bright red-yellow, tube curved, to 1¼ in. long, upper segm. ligulate. Natal. Var. **màjor,** Hort. A form with larger lvs. and fls.

220. Anthericum Liliago.

crocosmioìdes, Hort. Said to be a hybrid of *A. paniculata* and Crocosmia: 3 ft.: spikes branching; fls. brilliant orange-red, shaded to gold.

A. abyssínica, Brongn. Corm globose, 1 in. diam.: st. 2 ft. or less: lvs. 3–4, linear, 1 ft. long: spike simple, few-fld.; fls. bright red, the curved tube 1 in. long. Abyssinia.—*A. quadrangulàris,* Burm. (Gladiolus quadrangularis, Ker.). Corm large, globose, plant stoloniferous: st. slender, 2–3 ft.: lvs. 2–3, narrow: spike very lax, 2–4 fld.; fls. bright red and yellow, tube 2 in. long. Cape.—*A. Schweinfúrthii,* Baker. St. terete, 1 ft. to spike: lvs. 5 to 6, grass-like, 6 in. long: spike simple and lax, many-fld.; fls. bright red shading to yellow, about 1½ in. long, the tube curved and dilated. Abyssinia. B.M. 7709.

L. H. B.

ANTHOXÁNTHUM (Greek, *anthos*, flower, and *xanthos*, yellow). *Gramíneæ*. Aromatic grasses with spike-like panicles. Spikelets with 1 awnless perfect floret, and two 2-lobed, awned sterile lemmas. Species 4, Eu. A perennial species, sweet vernal grass (*A. odoràtum*, Linn.), is occasionally cult. as a meadow grass to give a pleasant odor to hay. Dept. of Agric., Div. of Agrost., Bull. 20:55. Another species, an annual (*A. Puélii*, Lecq. & Lam.), is more rarely cult.

A. S. HITCHCOCK.

ANTHRÍSCUS: *Chervil.*

ANTHÙRIUM (Greek, *tail-flower*). *Aràceæ*. Choice hothouse foliage plants.

Perennial, the st. creeping, climbing, assurgent or arborescent: lvs. variable, net-veined, with a prominent midnerve and lateral nerves, and a well-defined nerve at or near the margin: fls. in a spike (spadix), subtended or inclosed in the spathe: fr. a berry. Tropical herbs and climbing plants of perhaps 608 species besides varieties, mostly from the central and warmer parts of S. Amer., though probably not one-tenth are in cult. in this country. Grown either for their showy spathes and spadices, or their handsome velvety lvs. Spathe usually spreading or even reflexed, only rarely partially inclosing the spadix. Differs from Alocasia and allied genera in technical characters. Monogr. by Engler in De Candolle's Monographiæ Phanerogamarum, Vol. 2 (1879), and Pflanzenreich, hft. 21 (1905).

The genus Anthurium appears to be a constantly increasing one as regards the number of species. Index Kewensis, when first issued in 1893, gave the number of known species as 213. The supplements have now recognized 365 more species, making in all about 578 known species, though there are probably not more than fifty in cultivation in this country and perhaps not more than ten or fifteen known to the trade. Of those that are in cultivation there are several varieties or hybrids, as the species seem to cross readily.

Anthuriums are tropical aroids of great beauty, and at least a few species should be included in every collection of choice plants. They seem to fall naturally

221. Stolon of Anthericum Liliago.

into two sections or groups, viz., foliage and flowering. Although anthuriums all flower, those that have the large handsome velvety leaves, such as *A. crystallinum*, *A. Warocqueanum*, *A. splendidum*, and the like, have very inconspicuous or decidedly unattractive flowers, while *A. Andræanum*, *A. Brownii*, *A. Regnellianum* and *A. Scherzerianum* and many others have remarkably showy, usually scarlet spathes and spadices but much less handsome foliage. All are striking plants.—Anthuriums such as *A. Andræanum*, *A. ornatum*, and their numerous hybrid progeny, require at all times a high and humid atmosphere. Under these conditions and in a good rooting medium, they ought to be continually in flower. A bloom is produced from the axil of each leaf, and immediately beneath this leaf a new root is produced, thick and succulent at first, becoming tough with age, and, if not allowed to bury itself among the compost in which the plant grows, it eventually hardens and is of no help in the sustenance of the plant. Therefore, the growing point of the specimens should not be allowed to get too high, or the flowers will be few and poor. When the plant forms stems above the pot, the compost should either be built up around the stem, to catch the roots, or the plant may be cut over, rooted afresh in sand, and given a new start in a pot. The two ornamental-leaved species, *A. Veitchii* and *A. Warocqueanum*, should be treated in the same manner. When cut down, one may look for the old stocks to send out small growths, which in course of time may be taken off and put in small pots. All of the above are such free-rooting kinds that they may, with the addition of some rotted manure, be grown in sphagnum moss. A good mixture is as follows: sphagnum, chopped not too fine, one part; fern or kalmia roots, chopped up and the fine substance removed, one part; another part to be made up equally of sand and rotted manure. With well-drained pots, this forms an admirable rooting substance.—Most of the other species and their forms, including *A. Scherzerianum* and *A. crystallinum*, will thrive better in material mainly composed of rough, fibrous loam and peat with the fine material sifted from it. This rough, fibrous material should be mixed with a small quantity each of sphagnum, charcoal and sand. Good drainage, and less water than is needed for the Andreanum and Warocqueanum groups will be necessary. *A. Scherzerianum*, although thriving well in the hottest house, will succeed in an intermediate house.—Established plants of anthurium will need repotting only once in two or three years, but should have a fresh top-dressing every year; the best time to overhaul them is about the end of January, or before active growth begins. They should be given a shaded position, free from draughts of cold air, and ordinary stove temperature. Care must be taken not to mar the leaves by hard spraying. The temperature during winter should not fall below 55°.—Propagation is by suckers or cuttings of the rhizome inserted in small pots containing a mixture of peat fiber, chopped sphagnum moss and silver-sand in equal proportions, and plunged in a propagating-box in a temperature of 75° to 80°, with bottom heat. About the end of January is the most suitable time to take the cuttings. Anthuriums may also be propagated by seeds sown in a mixture of very fine fibrous peat and chopped sphagnum moss in 4-inch pots. The seeds should be lightly covered with sphagnum, and the pots placed either in a propagating-case or under bell-glasses, where a temperature of 80° can be maintained. A constant humid atmosphere is very necessary to induce the seeds to germinate. To prevent damping, the seedlings should be pricked off round the edge of a 3-inch pot as soon as the first leaf is large enough to handle. Seeds of such kinds as *A. crystallinum* and *A. regale* will germinate well on the moss of nepenthes baskets.

222. Anthurium Scherzerianum. (×⅛)

Seeds are secured by pollinating the flowers, the stigmas of which become mature long before the anthers. Anthuriums of the Scherzerianum type may be increased by division of the crown. (E. J. Canning and G. W. Oliver.)

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A. *Lvs. plain green: grown mostly for the showy "flowers."*

B. *Spadix coiled.*

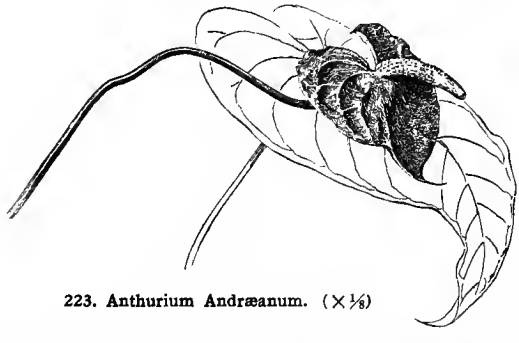
1. **Scherzerièanum,** Schott. Fig. 222. A foot or two high, evergreen: lvs. long-lanceolate (the blade 1 ft. or more long and petiole of nearly equal length), thick, usually somewhat revolute, with a strong vein parallel with each edge and close to it, and many cross-veins: scape long and slender (1–2 ft.), red; spathe ovate-oblong, 3–4 in. long, spreading or deflexed, intense red (sometimes double, I.H. 37:107); spadix slender, curled, yellow. Cent. Amer. B.M. 5319. R.B. 22:121. Gn. 33, p. 89. G.C. II. 12:301. G. 3:55. A.F. 6:569 (in variety).—An old favorite. Runs into many forms: spathe white, vars. **álbum, álbum magnífícum, lácteum, máximum álbum, Wílliamsii, Vervænèum**; spathe parti-colored, vars. **andegavénse** (scarlet on the back, white and scarlet spotted above), **mutábile** (white-bordered), **nebulósum** (double white spotted rose), **Rothschildiànum** (scarlet mottled white, Gn. 30:454), **Warocqueànum,** not *A. Warocqueanum* (white spotted red); spathe very large, vars. **gigantèum, máximum, Wárdii, Woódbridgei.** Very dwarf is var. **pýgmæum**; rose-salmon spathe and orange spadix is var. **parisiénse**; sharp pointed lvs. and spathes is var. **Bénnettii**; rose-colored spathes, var. **róseum**; deep blood-red spathes, var. **sanguíneum.**

BB. *Spadix not coiled.*

C. *Spathe narrow, green.*

D. *The lvs. narrow, not cordate.*

2. **spathiphýllum,** N. E. Br. Two ft. or less, stemless or nearly so: lf.-blade 2 ft. or less, narrow-lanceolate, attenuate in a straight line from the middle to the base, acuminate, bright green above and grayish beneath,



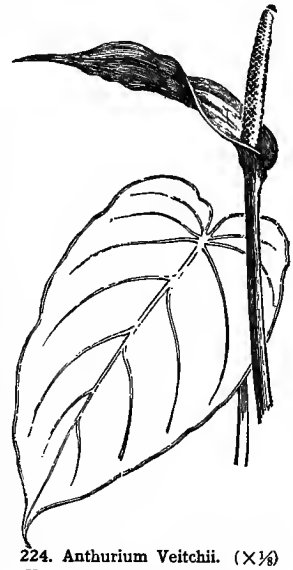
223. Anthurium Andræanum. (×⅛)

with prominent midrib: spathe 2 in. or less long and a half or more as wide, erect, boat-shaped, pale green or whitish; spadix 1 in. long and very blunt, pale yellow. Trop. Amer.

3. **Regnellièanum,** Engl. Lvs. 5–6 in. long, about 2 in. broad, obtuse or slightly emarginate at the base, gradually narrowed to an acute apex, green: spathe about 1½ in. long, ¼–⅓in. broad; spadix dark green, 1½–2 in. long, on a short stipe. Brazil.

DD. *The lvs. broad, deeply cordate.*

4. **Brównii,** Mast. Lvs. 2–3 ft. long, a deep sinus separating the rounded basal lobes, leathery, dark shining green above, paler beneath, with 12–15 pairs of prominent lateral nerves: spathe 6–8 in. long, lanceolate, greenish, rose-tinted; spadix 10–15 in. long. Colombia. G.C. II. 6:744–5.



224. Anthurium Veitchii. (×⅛) Young leaf, not yet showing the arched depressions.

CC. *Spathe cordate-ovate, colored.*

5. **Andræànum,** Lind. Fig. 223. Low species, with lf.-blades drooping like an alocasia and cordate ovate-lanceolate: spathe cordate-ovate, thick in texture, 6–10 in. long, orange-red, widely open-spreading; spadix 3–4 in. long, yellowish, with white band marking the zone in which the stigmas are receptive. Colombia. B. M. 6616. A.F. 6:569; 10:1065. Gt. 38:1293. I.H. 24:271; 37:105. V. 9:259; 11:138. G.C. II. 13:497.—Beautiful and popular. Runs into many varieties. Spathes white, var. **álbum**; spathe very bright red, shining, var. **Gámeri** (R.H. 1907:30, desc.); spathes very large, pure white, var. **Láwrenciæ**; spathes of a soft rose-color in upper part passing into light green on lateral lobes, var. **rhodochlórum** (R.H. 1901:452); spathes shining rose-pink, var. **róseum**; spathes salmon-color, var. **salmóneum**; spathes dark crimson, var. **sanguíneum.**

AA. *Lvs. prominently marked with white or colors, or with deep bands of green: cult. mostly for foliage.*

B. *The lvs. not bullate.*

C. *Markings green or greenish.*

6. **Vèitchii,** Mast. Fig. 224. Tall and robust species (st. 2–3 ft.): lf.-blades pendent, like a fine alocasia, often 3–4 ft. long, cordate or eared at base, metallic green, but marked by deep-sunk nerves, which arch off the midrib: spathe 1 ft. long, horizontal, green; spadix 6–8 in. long, straw-color. Colombia. G.C. II. 6:773. B.M. 6968. Mn. 8:187. I.H. 27:406. Gn. 29, p. 453. G.C. III. 44:181.—Striking.

CC. *Markings white or essentially so.*

7. **Warocqueànum,** Moore. Fig. 225. Very vigorous: lvs. oblong-lanceolate, long-tapering, hanging, 2–4 ft. long, deep velvety green, with rib and principal veins of a prominently lighter shade, making handsome contrasts. Colombia. I.H. 27:392. G.C. III. 44:180.—A handsome and striking foliage plant.

8. **magnífícum,** Lind. Lf.-blade deep cordate, oval, 2 ft. long, upper surface olive-green with white nerves; petiole 4-angled: spathe small, oblong, green; spadix green, cylindrical. Colombia.

9. **crystallìnum,** Lind. & André. Like *A. magnificum;* differs in petiole terete or only very imperfectly angled, sinus of blade smaller, veins wide-banded and whiter and very regular: lf.-blade ovate-cordate, short, deep velvety green, with the midrib and two consecutive bands crystal white: spathe linear-oblong, acuminate,

green. Peru. I.H. 20:128. G.C. III. 24:417 (var. *illustre*). G. 21:98. G.W. 15, p. 254.

10. regâle, Lind. Lf.-blade cordate-oblong, long-cuspidate, 3 ft. or less, at first tinged rose, but becoming dull green and marked with white veins; petiole nearly terete: spathe broad-lanceolate, greenish. Peru.

BB. *The lvs. bullate.*

11. spléndidum, Hort. Lvs. large, cordate-ovate, coriaceous, sea-green, glaucous above, bullate, the depressions and nerves brownish. Colombia.

Various horticultural forms and hybrids are in cult. in this country: *A. amábile.* Lvs. soft rose (crystallinum × magnificum).—*A. Archidùcis Jòsephii,* Lind. Spathe shining carmine, broadly cordate (Andræanum × Lindenianum).—*A. atropurpùreum,* Pynaert. Spathes black-purple, spadix white.—*A. bícolor,* Crousse. Spathe white beneath, above whitish and rose-colored. R.H. 1904:40.—*A. cárneum* is a hybrid of Andræanum and ornatum.—*A. Chantiniànum,* Mart. Spathe rose, with paler nerves.—*A. Chantrièri.* Lvs. triangular, with wide-spreading basal lobes: spathe ivory-white, erect (nymphæfolium × subsignatum).—*A. chelseiénse,* N. E. Br. (Andræanum × Veitchii). G.Z. 31, p. 169.—*A. Clarkiànum.* Lvs. large and broad: spathe resembling that of Andræanum but salmon-rose.—*A. ferrierénse.* Lvs. large, cordate: spathe cordate, brilliant red (ornatum × Andræanum).—*A. floribúndum,* Lind. and André = Spathiphyllum floribundum. I.H. 21:159.—*A. Frèbelii.* Lvs. large and cordate: spathe deep carmine (Andræanum × ornatum).—*A. grándе* = A. magnificum.—*A. Hrùbyi,* Hort. Spathe flesh-colored or almost white.—*A. hýbridum.* Lvs. large, lobed at base, obtuse, green.—*A. musàicum.*—*A. ornàtum.* Lvs. oval or oblong, cordate: spathe linear-oblong, white, purple-tinted.—*A. Reynoldsiànum,* various forms (ferrierense × Andræanum?).—*A. Siebrechtiànum.* Lvs. much as in *A. magnificum,* rich, velvety green, with thick margins: spathe light green shading to cream; spadix large, crimson.—*A. triúmphans.* Lvs. long-heart-shaped, bright green with lighter veins: spathe narrow, green; spadix greenish white.

225. Anthurium Warocqueanum.

A. acaùle, Schott. Fls. fragrant: lvs. 1–2½ ft. long, very broad. W. Indies.—*A. acútum,* N. E. Br. Lvs. 8–10 in. long, triangular and long-acuminate, green: spathe reflexed, green; spadix deep green. Brazil.—*A. Allendórfii*=Andræanum × Grusonii.—*A. Bàkeri,* Hook. Lvs. elliptic-lanceolate or linear, green: apathe small, reflexed, green; spadix 3 in. long, yellowish green, becoming longer and red and drooping in fr.—the chief merit of the plant. Costa Rica. B.M. 6261. G.C. III. 29:2.—*A. bogoténse,* Schott. Lvs. with a very broad halberd-shaped base and a long-acuminate middle lobe, dark green. Gt. 46, p. 525.—*A. brevilobum,* N. E. Br. Lvs. oval-acuminate, cordate, 8–10 in., paper-like, green: apathe lanceolate, purplish; spadix purplish brown.—*A. cárneum,* Hort. Chant. Spathe a beautiful rose color.—*A. Chàmberlainii,* Mast. Lvs. 4 ft. long, broadly cordate-ovate ,and narrowly long-pointed, green: spathe erect, boat-shaped, 8–9 in. long, purplish outside, crimson inside, partially incloaing the purplish spadix. Venezuela. G.C. III. 3:465. I.H. 35:62. B.M. 7297.—*A. Clémentinæ,* DeSmet. Spathe white with rosy nerves.—*A. coriàceum,* Endl. Lvs. very thick, leathery, 2 ft. long. Brazil.—*A. Eduárdii,* Pynaert. Spathe white (Andræanum × Lindenianum).—*A. Forgétii,* N. E. Br. Related to A. crystallinum, but smaller and with peltate lva. of a deep rich green with a velvety sheen, the veins not quite so marked. Colombia.—*A. Glaziòvii,* Hook. Lf.-blade obovate-oblong, not hanging; tapering to petiole, green and strongly light-veined: spathe linear-oblong, often twisted, purple (as is also the spadix). Brazil. B.M. 6833.—*A. grandiflòrum* var. *perféctum,* Hort. Spathe very large, of a pronounced red color.—*A. Gustávii,* Regel. Lvs. broadly ovate-cordate, bright green: spathe cylindric, about 1 ft. long, and dark violet-purple like the spadix. Colombia. B.M. 7437.—*A. Hardyànum,* Mart. Spathe rose, spadix white.—*A. Hoòkeri,* Kunth. Lvs. dotted with black, spathe lanceolate. B.M. 2987 (as Pothos crassinervia). W. Indies.—*A. insígne,* Mast. G.C. II. 6:365.=Philodendron tripartitum.—*A. Kalbrèyeri,* Hort. Climbing: lvs. 9-parted. Colombia. G.C. II. 16:117.—*A. Laucheànum,* Hort., Sand. Resembles A. Andræanum, but lvs. reticulated: sts. climbing. Colombia. G.C.III. 43:258.—*A. Lindeniànum,* Koch & August. Lvs. ovate-cordate, green, coriaceous: spathe pure white, linear-oblong, 5-6 in. long; spadix dark purple. Colombia. B.M. 5848. F.M. 1876:236 (both as *A. ornatum*).—*A. Miqueliànum,* Koch. St. climbing: lvs. shining, elliptic-oblong, 1–2 ft. long: spathe lanceolate, green. Brazil. G. 7:435 (as *A. ornatum*).—*A. Nicolasiànum,* Engl. Spathe yellowish, flushed with rose.—*A. nymphifòlium,* Koch. Spathe white; spadix purple. Venezuela.—*A. purpùreum,* N. E. Br. Lvs. oblong-lanceolate, thick, green: spathe and spadix purple. Brazil.—*A. rotundispàtheum,* Lind. & Rod. Spathes nearly round, intensely sanguineous.—*A. Sánderi,* Hort. R.B. 34, p. 196.—*A. signàtum,* Koch. Lva. 3-lobed, deep green. Venezuela. *A. trífidum,* Oliver (B.M. 6339)=A. signatum.—*A. trinérve,* Miq. Climbing: lvs. oblong-elliptic, 4–7 in. long: spadix up to 2 in. long, ¾in. thick in fruit: berries lilac. S. Amer. B.M. 8251.—*A. watermaliénse,* Hort. Allied to A. Andræanum. Spathes of a metallic black. Colombia. Intro. from Watermall, Belgium.

L. H. B.
GEORGE V. NASH.†

ANTHÝLLIS (Greek, meaning *downy flowers*). KIDNEY VETCH. *Leguminòsæ.* Perennial herbs, or somewhat shrubby, prized for their spikes or heads of yellow, purple or white flowers and usually silky pinnate foliage; also for forage; in the Old World, prized mostly for rockwork.

Calyx-tube inflated near the base, dentate or lobed above; petals pea-like; the stamens all connected into a tube: legume usually ovoid.

The culture is the easiest, as the plants thrive even in poor soil. Propagation is by seeds or division, or, rarely, by soft cuttings. Not generally known in United States.

A. *Lfts. 4 or more pairs.*

Vulnerària, Linn. SAND CLOVER. WOUNDWORT. A foot high: lfts. 5 or more: fls. normally yellow, but there are red and white varieties. Eu.—A deep-rooted, clover-like, hardy plant, excellent for sandy and light lands. Useful for forage, and, for that purpose, occasionally grown in this country. Requires 20 lbs. of seed to the acre. See Cyclo. Amer. Agric., Vol. II, p. 308 and fig. 416.

montàna, Linn. A foot or less high, silky-hoary: lfts. numerous: fls. purple in dense heads subtended by a leafy involucre. Herbaceous. Var. **rùbra,** Hort., is a reddish fld. form suitable for rock-gardens. Eu. L.B.C. 6:578.

Bárba-Jòvis, Linn. JUPITER'S BEARD. Glasshouse silky evergreen, 3–8, or even 12 ft. high, with several to many pairs of narrow, pointed lfts.: fls. straw-colored or whitish, in clover-like heads. S. Eu. B.M. 1927.—In frostless countries, endures sea-winds and salt spray.

AA. *Lvs. unifoliolate or trifoliolate.*

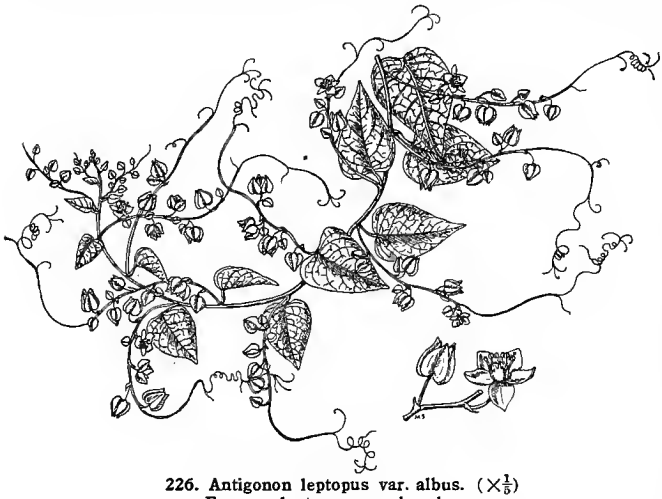
Hérmanniæ, Linn. Two to 4 ft.; dwarfer and more bushy than the preceding: lvs. almost sessile, simple or trifoliolate, the lfts. oblong-cuneate: fls. yellow in axillary almost sessile, few-fld. heads. S. Eu. B.M. 2576.—Good for dry places. Intro. by Franceschi in 1910.

N. TAYLOR.†

ANTIÀRIS (name derived from Greek word for *arrow,* the sap being used for arrow poison.) *Moràceæ.* Five or 6 trees or shrubs of the E. Indies and Malaya famous because of the upas-tree, **A. toxicària,** Lesch., fabled for years to be so poisonous that men or animals were destroyed who came within some distance of it. These

legends are apparently Javan. The tree has been grown in botanic gardens, however, with no disastrous results. The dried milky juice is very poisonous, and the natives use it with other ingredients (the ipoh poison) for poisoning arrows. The tree grows 60–70 ft. high, with alternate distichous short-std. oblong or oblong-ovate, entire lvs. and monœcious fls., the sterile fls. in dense heads and the fertile fls. solitary: fr. a 1-seeded fleshy drupe. A fiber is yielded from the inner bark. Another species, **A. innóxia,** Blume, yields fiber that is used for the making of sacks.

ANTIDÉSMA (Greek, *for* and *band*, the bark of *A. Bunius*, being used for cordage). *Euphorbiàceæ.* Tropical trees rarely cult. Lvs. large, alternate, simple: fls. small, in spikes; calyx imbricate; petals none; ovary 1-celled, 2-ovuled. The 1 species cult. for its currant-like berries used in preserves. The very tough fiber of the bark also used. The tree is very ornamental and suited to the subtropical parts of this country. Prop.



226. Antigonon leptopus var. albus. (×⅕)
From a plant grown under glass.

by cuttings. There are about 70 other species in the warmer parts of the Old World.

Bùnius, Spreng. NIGGER'S CORD. SALAMANDER TREE. CHINESE LAUREL. BIGNAY of Malays. A medium-sized evergreen tree with dark green laurel-like foliage, and small red berries in racemes. Malay region.

Two similar shrubs, *A. nitidum*, Tul., from Malaya, and *A. venòsum*, Mey., from S. Afr., have been intro. by U. S. Dept. of Agric. J. B. S. NORTON.

ANTIGÒNON (name from Greek, probably referring to the kneed or angled character of stem). *Polygonàceæ.* Showy-flowered climbers, abundant in southernmost United States and southward, and sometimes grown in warmhouses.

Tropical tendril-climbers: sepals 5, colored petal-like and cordate, the 2 interior ones narrower; stamens 8; styles 3, and ovary 3-angled: lvs. alternate and entire: fls. in racemes, which end in branching tendrils. —Species 3 or 4, in Mex. and Cent. Amer.

The usual species is *A. leptopus*, one of the most conspicuous and beautiful climbers grown in Florida, and always in flower from early spring to late autumn. It grows 30 to 40 feet high in good soils. Some plants are shy bloomers, while others are often covered from top to bottom with a mass of bright deep rosy red. Too much fertilizer effects a very vigorous growth at the cost of the flowering. Verandas covered with antigonon look extremely beautiful, and cabbage palmettos decorated with masses of its pendent flower-trusses form charming objects. The plants form large tubers and when killed down by frost, sprout readily again in spring. Seeds, looking much like buckwheat, are abundantly produced and form a ready means for propagation. Small plants from self-sown seeds come up everywhere in Florida gardens. (H. Nehrling.)

léptopus, Hook. & Arn. MOUNTAIN ROSE. ROSA DE MONTANA. SAN MIGUELITO. CORALLITA. LOVE'S CHAIN. Plant tuberous-rooted: st. slender and tall, glabrous, or nearly so: lvs. cordate and acuminate, or hastate-ovate, 3–5 in. long: fls. 6–15 in the raceme, handsome rose-pink. Mex. B.M. 5816. G.C. III. 17:797. Gn. 68, p. 320. G.M. 49:317. Var. **álbus,** Hort. (Fig. 226), has fls. nearly or quite white.—One of the handsomest summer-blooming greenhouse climbers, requiring abundance of light and recommended to be planted near heating-pipes and to be trained on the rafters; usually grown from seeds, but also from cuttings. Give plenty of water when in flower but keep dry when at rest. In the S. and the American tropics it is one of the commonest vines on fences, arbors and verandas.

guatemalénse, Meisn. (*A. insigne*, Mast.). Pubescent: lvs. broader: fls. more numerous, the sepals nearly twice longer (1 in. long) than in the last. Guatemala. G.C. II. 7:789.

L. H. B.

ANTIRRHÌNUM (Greek, *snout-flower*). *Scrophulariàceæ.* SNAPDRAGON. Flower-garden and greenhouse herbs.

Erect or climbing herbs or even half-shrubs: lvs. usually opposite below and commonly entire, never compound: corolla saccate or gibbous at base, but not spurred, personate or closed at the throat; stamens 4: seeds not winged.—Closely allied to Linaria, from which it differs in the spurless fls. About 30 or 40 species in the northern hemisphere, particularly in N. Amer.

Snapdragons are flowered either in the open or under glass. The common varieties are forms of *A. majus*, and are perennial, although the first crop of bloom is usually the only one that is desired. Most of the varieties of this species are hardy in the North, if well covered during winter. Seeds sown very early in the spring, especially under frames, and transplanted, produce blooming plants the same season. It is usual, however, if early bloom is desired, to sow the seeds in August or September, and cover the plants with a mulch on the approach of cold weather. These fall-sown plants may be transplanted into pots (or grown in them from the first) and flowered in the house. For growing under glass in this way, snapdragons are very satisfactory. The temperature and treatment required for geraniums and carnations suit them well. Dwarf varieties are used for edgings.

A. *Plant erect, herbaceous.*

B. *Root annual: small-fld.*

Oróntium, Linn. SMALL SNAPDRAGON. Fig. 227. A low, slender annual, with linear lvs. and small fls. purple or white (⅓in. long) in the axils. An occasional weed in cult. grounds, 6–12 in. high; not cult.

Orcuttiànum, Gray. Slender, 2–4 ft., glabrous: corolla ⅓in. long, white or violet, lower lip not much larger than the upper: lower lvs. spatulate-lanceolate, the upper linear. Lower and S. Calif.—Intro. by Orcutt in 1891. Tendril-like branchlets are produced in the fl.-clusters.

BB. *Root perennial: large-fld.*

màjus, Linn. COMMON or LARGE SNAPDRAGON. Fig. 228. Perennial, or practically a biennial under cult.: 1–3 ft., not downy except in the fl.-cluster: lvs. oblong or lanceolate, entire, sometimes variegated: fls. large,

long-tubular, with spreading, very irregular lobes, in an elongated terminal spike or raceme. In many colors and varieties (ranging from red and purple to white), in forms both tall and dwarf. Medit. region; sometimes running wild about gardens. A.F. 9:909; 13:949. I.H. 41:22. A.G. 17:379. F.E. 7:711.—There are double forms. Some of the varietal names used by horticulturists are *álbum, bícolor, coccíneum, pròcerum, pùmilum, variegàtum.* Peloric forms are reported, with regular corolla and the much-reflexed limb 5–7-lobed. Gt. 53:1524.

227. Antirrhinum Orontium. (×¼)

AA. *Plant erect, perennial and shrubby: fls. about 1 in. long.*

speciòsum, Gray. Three to 4 ft., somewhat pubescent, leafy: lvs. oval or oblong, short-petioled, thick: fls. scarlet or pink-red, the corolla-tube three times length of the lips (which are narrow). S. and Lower Calif., on the islands.

AAA. *Plant trailing or procumbent, perennial, with small fls.; used mostly in rock-gardens. June, July.*

Asarìna, Linn. Grayish-clammy, procumbent: lvs. 5-lobed, cordate, crenate, long-petioled: fls. axillary, solitary, white and sometimes tinged red, the palate yellow. S. W. Eu.

sempérvirens, Lapeyr. Procumbent, woolly, small: fls. white with purple blotch. Pyrenees.

glutinòsum, Boiss. & Reut. Prostrate, glandular-pilose: lvs. alternate, elliptic to elliptic-ovate, short-petioled: fls. pale yellowish white, the lip striped red. Spain. B.M. 7285.

AAAA. *Plant climbing, perennial.*

maurandioìdes, Gray (*Maurándia antirrhiniflòra,* Willd.). Fig. 229. Climbing 2–6 ft. by means of the coiling petioles and peduncles: lvs. 3-lobed, halberd-shape: fls. axillary, 1 in. or more long, violet or purple, handsome. Texas to Calif. B.M. 1643.—Attractive plant for the window, cool greenhouse or conservatory. Suitable for baskets. L. H. B.

ANTRÒPHYUM (Greek, *growing in caverns*). *Polypodiàceæ.* A genus of simple-lvd. herbaceous ferns, rarely found in cult. Native in tropics, in damp forests. All the species are epiphytes, and not of commercial value except as rarities. Require high temp.

ANTS, Their Habits, Activities, Injuries and Control. Various kinds of ants are troublesome to gardeners; and all the ants are most interesting animals.

The ants belong to the same great group of insects (Hymenoptera) that contains the wasps, bees, sawflies, and others; and like the honey bee and common wasps are congregate in their habits of living. The abdomen of all the common ants is attached to the thorax by a slender waist, or peduncle; and each segment (there may be one or two) of this peduncle is expanded on the top side and forms a lens, or button-shaped knot, a character that distinguishes ants from all other insects.

Everyone is familiar with ants; they occur in all lands and all regions, from the dry deserts to the damp forests, from the timber line of mountains to the lowest valleys and among the dwellings and habitations of man. They seem to thrive in all kinds of environment and multiply enormously, so that they outnumber all other terrestrial animals.

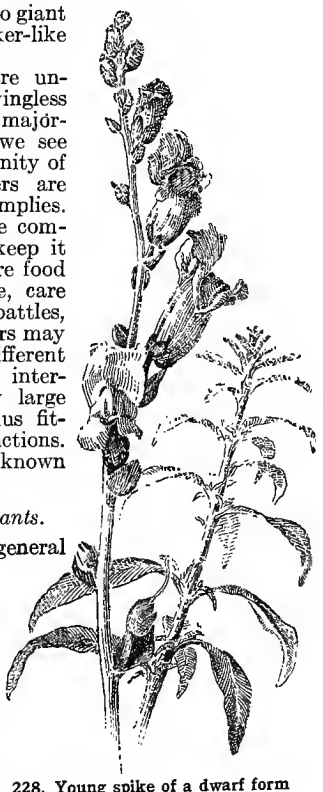
The nature of an ant colony.

Ants are social; that is, they live in colonies or communities where every individual ant works for the good of the whole and not for itself alone. A colony of ants furnishes an illustration of a more perfect communistic society than any ever established by man, and perhaps a more amicable one than any he will ever be able to organize.

In a typical colony of ants, there are at least three kinds of individuals, the queen, the males, and the workers. The queen is not the ruler but the mother of the colony. Her only business seems to be to lay eggs which hatch into workers and other forms to take the places of those that disappear or die, thus maintaining the full and continuous strength of the community. When the queen comes forth from the pupal stage, she has wings which she retains until after the swarming period. After the swarming flight is over and the queen alights, her wings fall off or are torn off by herself or workers and from that time she remains wingless. In some species of ants there may be modified forms of the queen, for example, giant queens, dwarf queens, worker-like queens, and other forms.

The males, which have wings, exist only to mate with the queens, and after the swarming period is over they eventually die. The males are also often modified into giant males, dwarf males, worker-like males, and other forms.

The workers, which are undeveloped females, are wingless and constitute the great majority of individuals that we see running about in the vicinity of an ant-nest. The workers are just what their title implies. They do the work of the community, build the nest, keep it clean, care for and procure food for the queen and larvæ, care for the eggs, fight the battles, and so forth. The workers may exist under several different forms. One especially interesting form has a very large head and strong jaws, thus fitting it for war-like functions. Ants of this form are known as the soldiers.



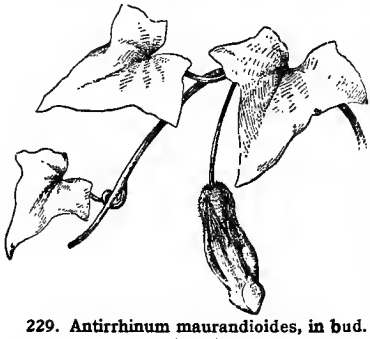
228. Young spike of a dwarf form of Antirrhinum majus. (×⅓)

The nests and activities of ants.

The nests of ants, in a general way, consist merely of a system of passage-ways or cavities communicating with each other and connected to the outside world with one or more openings. There are some species of ants that live below the surface of the earth and have no openings from their nests into

the air, except at the swarming period. The style of construction and the materials used by ants in making their nests vary with the different species and with the environment in which the animals live. Moreover, the nests are very irregular, especially when compared with those of wasps and bees.

The passageways of the nests are enlarged here and there into comparatively large cavities, or chambers. It is in these different chambers that the activities of the colony are conducted. The queen lies deep within the interior of the nest in a dry, dark chamber. Here she is carefully tended and fed by the workers who bear the eggs as they are laid, to other chambers and zealously care for them. Many insects never see their young; others may see them but do not care for them; others, like the bees and wasps, put food into the gaping mouths of their young but have no further association with them. The ants, however, stand alone among insects in their very intimate relations with their progeny from the egg to the adult. Some of the chambers in the nest are reserved for the eggs, some for the larvæ, and some for the pupæ. If, as often happens, the eggs, larvæ and pupæ are all in one chamber, then they are each grouped by themselves in separate piles, reminding one, as Lubbock says, "of a school divided into five or six classes." In the simpler and more primitive ants, this grouping and separation may not be so distinct. The ants are constantly transferring their young from one part of the nest to another in search of the right degree of moisture, temperature, and the like. In the warm part of the day, the young will be transferred to near the surface but at night will be carried down again away from the cool air. The ants are constantly cleaning the young, caring for the eggs to prevent mold from growing on them, helping the callow ants to emerge from their cocoons, bringing food, cleaning, enlarging and reconstructing the nest and doing thousands of things contributing to the comfort, growth and happiness of the community.



229. Antirrhinum maurandioides, in bud. (×½)

The relation of ants to plants and to insects.

It has been argued and many observations have been offered to show that there is a most intimate relation between ants and many kinds of plants. Certain observers think that many plants not only offer special inducements to attract ants to them by affording favorable nesting-places, but also offer the ants delectable food in the way of a sweet liquid, the floral and extrafloral nectar. In return for the domiciles and the food, the ants are supposed to protect their plant hosts from certain insect and other animal enemies. In other words, the relationship is one of mutual benefit, or a symbiotic one. It is certainly true that many species of ants make their homes in the hollow stems of plants, in the thorns of acacias which the ants easily hollow out (see *Bull-horn Acacias*), in cavities in bulbs, leaves, and so on, and in the dried seed-pods of plants. It is also true that ants assiduously collect and carry to their nests the sweet nectar excreted by many plants. It is not so clear, however, that these favorable nesting-places and the nectar are provided by the plants on purpose to attract the ants, nor is it clear that the ants afford the plants protection from their animal enemies. In other words, more definite proof is needed to show that the relation between ants and plants is a purposely mutual one.

On the other hand, the relation of ants to plant-lice, tree-hoppers and certain scale insects is clearly, in many cases, a mutually helpful one. Especially is this true of the relations between ants and plant-lice. The aphids secrete a sweet liquid material known as honey-dew, of which the ants are very fond and which they are active in collecting and carrying to their nests. It can hardly be supposed that the aphids excrete the honey-dew solely for the ants. The liquid is an excretion from the alimentary canal and is exuded whether ants are in attendance or not. On the other hand, ants are very solicitous in their care of aphids in return for the honey-dew. The ants sometimes build "sheds" over the lice for their protection and sometimes take the lice into their own nests to care for them. In the case of the corn-root louse, the ants collect the eggs of the aphid in the fall, carry them into their own nests, and care for them all winter. In the spring, the newly-hatched aphids are carried out by the ants and placed in burrows dug beforehand among the roots of certain early food-plants. Later, the ants excavate burrows along the roots of the corn and transfer the aphids to these plants.

It is interesting to watch the ants collecting the honey-dew from the aphids. An ant approaches a louse and gently strokes the latter with its antennæ, whereupon the aphid exudes a drop of the sweet material which is quickly gathered up by the ant. This action may be repeated with three or four of the aphids until the ant has all it desires, when it hurries down the stem of the plant and away to its nest with its load of sweet provender.

The life-history of ants.

Enough observations have now been made to enable us to say that most, if not all, colonies of ants are started by a solitary queen or occasionally by two queens working together. The queen, after the swarming period, alights, breaks off her wings, and digs a burrow in the soil or in decayed wood, forms a small chamber, and then closes the opening. Here she remains until her eggs are laid and have hatched into small larvæ that finally mature into normal but diminutive workers. All this time the queen has taken no food but has lived and fed the first workers on the reserve material in her body. The small workers now begin to enlarge the nest and soon other larger workers are reared and the community begins to multiply and increase.

The eggs laid by the queen are small and white and rarely seen by the ordinary observer. These are solicitously cared for by workers and finally hatch into white, footless, soft, grub-like larvæ. The larvæ are also tenderly cared for by the workers and changed from chamber to chamber in conformity with variations in temperature and moisture. The workers feed the larvæ either on food which has been predigested and which the workers now regurgitate, or on bits of dead insects, leaves, or seeds that have been chewed fine. The larvæ finally, after attaining their growth, change to whitish pupæ which, in some species, are inclosed in cocoons, while in others they are not. These the workers treat with the same solicitude and care that they show toward the larvæ. The pupæ are often mistaken for eggs. Often, on raising up a flat stone, one will see the workers running this way and that with the larvæ and pupæ in their jaws, evidently seeking a place of safety for them. The pupæ finally transform to the adult ants of the various forms, workers, queens, and males.

Economic importance of ants.

Ants, as a whole, may probably be considered as agents in making the earth more habitable for man.

Some of the species are neutral, perhaps, in relation to the economic status of mankind. A great many species are certainly beneficial through their action in stirring and aërating the soil. They are constantly burrowing deep into the earth and bringing up the particles which they distribute over the surface. Their action in this respect is similar to that of earthworms, the value of which was revealed to us by the classic investigations of Darwin. Ants are also important agents in aiding in the decomposition of organic substances. Their work in this respect is little appreciated or realized because it is invisible. It must be remembered, however, that this work of ants is gradual, incessant, and extends through tremendously long periods of time.

Again, ants are great insect-destroyers. Their food consists, in great part, of the juices and tissues of dead insects or insects that they kill. The interesting driver ants of the Old World and the legionary ants of tropical Africa pass through a territory killing and devouring multitudes of living insects, rats, mice, and the like. Hunter and Hinds tell us that there are twelve species of ants known to attack the immature stages of the Mexican cotton boll-weevil. "In some cases more than half of the immature stages in fields have been found to be destroyed by ants alone. To find 25 per cent so destroyed is not a rare occurrence."

On the other hand, certain household species of ants are very annoying and troublesome. Moreover, the leaf-cutting ants of tropical America are very injurious to plants. They will strip a fruit tree of its foliage in a very short time. One species of these leaf-cutting forms (*Atta texana*) found in Texas, attacks cotton, corn, fruit trees, sorghum and other plants, and has become of considerable economic importance. In some places, land is not planted on account of fear of attack by these ants.

The mound-building prairie ant (*Pogonomyrmex occidentalis*), distributed over a large part of the western plains of the United States, has become a distinct pest since man has begun to occupy the prairies. Its large mound-nests in fields of alfalfa or grain become serious obstacles to harvesting the crops. Moreover, when the nests are disturbed, the ants emerge in large numbers and attack man and beast, inflicting painful wounds with their stings. In dooryards and lawns and along paths, they are liable to attack the passerby, especially dawdling children.

The agricultural ant (*Pogonomyrmex barbatus molefaciens*) of Texas may build its mound-nests in fields of alfalfa, corn, or cotton, and, since it allows no vegetation to grow over a considerable area around the nest, the injury may be serious. Moreover, they are pugnacious and sting intruders severely.

Perhaps the most injurious rôle assumed by ants is their protection and fostering of plant-lice, scale insects, and the like. Aphids and scale insects are among the most injurious insect pests, and anything that protects them or aids them in increasing may be considered an enemy to man.

As a pest, the Argentine ant (*Iridomyrmex humilis*), stands by itself. Professor Newell says, "As a household pest I venture the opinion that this ant has no equal in the United States." Unfortunately, it has also become a serious menace to horticultural interests as well. It destroys the buds, blossoms, and fruit of certain plants and protects and fosters certain scale insects that are very injurious to sugar-cane. Moreover, it has in a few instances actually shown itself to be dangerous to human life by nearly suffocating young infants.

The Argentine ant was probably first introduced into the United States through the port of New Orleans, and is now found in Louisiana, Mississippi, parts of California, and probably Texas. It is an exceedingly tenacious ant, holding on where once established, increasing with great rapidity, and driving out all the native ants.

The termites, or white ants.

The termites are not true ants. In fact, they stand at the opposite end of the insect-world, widely separated from the ants just discussed. They resemble the true ants, however, in many important respects. For example, they live in great colonies, and many tropical species build large mound-like nests. Moreover, in each colony there are several kinds of individuals, for example, the queen, the males, the workers which are blind or have imperfect vision, and, finally, the soldiers. The food of termites usually consists of dead or decaying wood, and the species in the United States live mostly underground or in old logs, in the timbers of buildings, or in the walls and floors of houses. Occasionally they injure young pecan and orange trees by mining into the stems and sometimes attack sugar-cane. The greatest injury performed by termites, however, is by burrowing into the sills and foundation-timbers of buildings, thus undermining the whole structure. They also injure books and documents stored in damp basements and sometimes become serious pests to greenhouses.

The control of ants in gardens, lawns and fields.

The only method of getting rid of ants permanently is by locating the nests and treating them in such a way that the queen will finally be destroyed. The substance most used for treating the nests is carbon bisulfide. One or more holes should be made in the nest with an iron bar and an ounce or two of the liquid poured into each hole. The openings to the holes should be quickly and tightly closed with a clod of dirt. A heavy wet blanket thrown over the nest will aid in retaining the gas and tend to make the fumigation more effective. The liquid evaporates and the gas penetrates the whole nest, killing queen and workers, thus exterminating the colony.

Within the past few years, several workers have used potassium cyanide with good success in destroying ants in the field. J. D. Mitchell conducted experiments against the leaf-cutting ant in Texas. He dissolved the cyanide at the rate of one ounce in one quart of water and poured a quart into each of the openings of the nests. In every case the colony was destroyed by one or two applications. This method may be followed to advantage in destroying ants in gardens and on lawns, but the solution may be made weaker—one ounce of the cyanide to two to four quarts of water. Best results will be secured by using 98 per cent pure potassium cyanide. It must be remembered that this is a deadly poison and great care should be exercised in handling and storing it. G. W. Herrick.

AÒTUS (*without ear;* no calyx appendages). *Leguminòseæ.* Greenhouse plant, blooming April to June in N.

Shrubs, with simple scattered or 3-whorled revolute-margined lvs., and yellow or reddish fls. in axillary clusters or short terminal racemes; calyx 2-lipped; petals long-clawed, the standard nearly orbicular and longer than lower petals, the wings oblong and keel incurved; stamens free: pod ovate, flat or turgid, 2-valved.—Ten or 11 species in Austral.

gracíllima, Meisn. Tall shrub, with long slender branches, hoary or slightly tomentose: fls. yellow with crimson or dark-colored keel, in long leafy dense racemes, the petals twice as long as calyx. W. Austral. R.B. 26:193. L. H. B.

APÈRA ARUNDINÀCEA: *Stipa arundinacea.*

APHANÁNTHE (Greek, *aphanes,* inconspicuous, and *anthe,* flower). *Ulmàceæ.* Ornamental deciduous tree cultivated for its foliage and sometimes planted as a shade tree.

Trees or shrubs: lvs. alternate, petiolate, serrate; stipules free: fls. monœcious, inconspicuous; staminate

in axillary corymbs; sepals and stamens 5; pistillate solitary, axillary; ovary 1-celled with 1 ovule, styles 2: fr. a drupe.—Three to 4 species in E. Asia and Austral. The only species in cult. is a deciduous tree of the appearance of a hackberry, with slender branches forming a dense head; fls. and fr. inconspicuous. Not hardy north of Ga. Prop. by seeds sown after maturity and by cuttings of mature wood in fall; it also may be grafted on Celtis.

áspera, Planchon (*Homoiocéltis áspera,* Blume. *Homocéltis japònica,* Hort.). Tree, to 60 ft.: lvs. ovate to ovate-oblong, broadly cuneate at the base, long-acuminate, 2–3½ in. long, serrate with straight veins ending in the teeth, with appressed hairs on both sides, rough to the touch, on short stalks ⅛in. long: fls. greenish, with the lvs.: drupe globular, black, ⅓in. diam., short-stalked. Early spring: fr. in autumn. Japan. S.I.F. 1:37.—This tree has been confused with *Celtis sinensis,* but is easily distinguished by the straight veins ending in the teeth, while in Celtis they are curved and form loops along the margin.

ALFRED REHDER.

APHELÂNDRA

(Greek-made name). *Acanthàceæ.* Tropical American evergreen shrubs or tall herbs, grown in hothouses for the fine foliage and very showy 4-sided terminal spikes of red or yellow gaudy-bracted flowers.

Leaves mostly opposite, simple, entire or toothed, usually many and large: fls. labiate, the upper lip mostly 3-lobed and the middle lobe erect or arching, the lower lip more or less 2-lobed or notched; stamens 4, rising from the base of the corolla, the anthers connivent and 1-celled; style 2-lobed: fr. a 4-angled caps.—About 60 species.

230. Aphelandra squarrosa var. Leopoldii. (×¼)

Aphelandras are of easy culture, if given plenty of diffused light in the growing season, and plants are not allowed to become tall and leggy. It is well to grow new plants frequently. Propagation is by seeds when obtainable, or by cuttings of partially ripened wood at any season or the young growths taken off with a heel. They bloom in autumn, but can readily be brought into flower at other seasons. When done blooming, the plants should be rested in an intermediate temperature, kept rather dry, but not allowed to wilt or shrivel. They require treatment of justicias, and thrive along with allamandas and poinsettias.

A. *Fls. in yellow series.*

squarròsa, Nees (*A. Lèopoldii,* Hort. *A. chrỳsops,* Bull). Lvs. large, ovate to ovate-elliptic, acuminate, dark green above (pale below), with white rib and main veins: infl. a simple, erect, or compound spike, up to 1 ft. long; fls. pale yellow and exserted one-third their length beyond the yellow crenate-dentate bracts. Brazil. *A. squarrosa* itself is not in cult., the showy plant in the trade (and described herewith) being Var. **Lèopoldii,** Van Houtte. Fig. 230. F.S. 9:889. G.C. III, 1, p. 737. Var. **Loùisæ,** Van Houtte. Dwarfer and smaller in all its parts than var. *Leopoldii:* St. slender, dark reddish green, terete, covered in parts with soft pilose hairs, upper part of the st. below the infl. quite glabrous: lvs. 3–5 in. long, elliptic, rich dark green with brighter colored silvery markings along the midrib and principal veins: infl. 3–6 in. long, unbranched; bracts ovate, ¾in. long, rich dark yellow, with green markings in the middle; fls. exserted beyond the bracts over half their length, rich canary-yellow, ½in. diam., lower 3 petals forming a lip and reflexed, upper 2 hooded, reflexing with age; tube broad, broadening out upwards with a narrow base, 1¼ in. long. Brazil. G.W. 3:157.

Chamissoniàna, Nees (*A. punctàta,* Bull). An erect herb or sub-shrub: sts. slender, erect, terete, green, lower part more or less woody: lvs. petiolate, elliptic or elliptic-lanceolate, tapering at apex and base, and up to 6 in. long, upper part light green, marked along the principal veins and midrib with dull silvery white or yellowish white, the silvery markings sometimes spreading over nearly the entire lf.; petiole short or up to an inch or more long, lower side dull light green: infl. an erect unbranched spike, as much as a foot long when strong and 2–3 in. wide; bracts ovate-lanceolate, bright yellow, tipped with green, coarsely serrate, slightly reflexed; calyx ½in. long; sepals lanceolate; corolla bright yellow, an inch diam.; tube 1½ in. long, curved outward and tapering upward; lobes ovate, nearly equal; anthers yellow. S. Brazil. B.M. 6627. I.H. 29:457.

Blanchetiàna, Hook. f. (*A. amæna,* Bull). St. terete, green, tinted with dull purple, with deeper shading around the base of petiole and at the nodes, thick and stout: lvs. ovate-acuminate, with many pairs of conspicuous nerves, green, the midrib, and often the main veins, white; petiole, 1–2 in. long, terete, glabrous: fls. dark yellow, exceeding the long, entire, cusp-pointed red scales: spike sessile. Brazil. B.M. 7179.—Known in the trade as *A. amæna,* having been described under that name before it had flowered in cult.

AA. *Fls. in red-orange series,—i.e., scarlet, or verging to orange.*

aurantiaca, Lindl. Lvs. ovate-elliptic, deep green above, light green below, strongly veined, but not particolored, slightly wavy edged: fls. orange, with a tinge of scarlet, the spreading limb overhanging the greenish sharp-toothed scales.—A dwarf-growing species of easy cult. and readily raised from seed. Mex. B.M. 4224. B.R. 31:12. Var. **Rèzlii,** Nichols. (*A. Rèzlei,* Carr.). Fls. with more scarlet: lvs. twisted, with silvery hue between the veins. Mex. Gn. W. 20:576.—Showy and good. Not so tall as *A. aurantiaca.*

Macleàyi, Bedd. Lvs. ovate-elliptic, 3 in. or less long, acute, entire, green both sides with white band along midrib above: spike cone-like, orange-scarlet, nearly 2 in. long. Country unknown.—Said to have been cult. as *A. punctata* and *A. squarrosa.*

tetragòna, Nees (*A. cristàta*, Lindl. *Justícia cristàta*, Jacq. *J. tetragòna*, Vahl). An erect or spreading, shrub: sts. terete, woody below, green, tinted with red when young: lvs. opposite and decussate, petiolate, green, glabrous or nearly so, elliptic or elliptic-ovate, acuminate or acute, 6–12 in. long, and 2–7 in. diam., entire or crenate, slightly undulate; petiole as much as 6 in. long, slender, hairy: infl. an erect-terminal cluster of spikes, the central one hairy, 6–8 in. long, with shorter ones branching from its base, often, when well grown, bearing from 10–12 lateral spikes of various lengths; fls. bright scarlet, crowded on the spike, and the bulk of them opening together; bracts erect, closely adpressed to the rachis, green, ovate, acute, ⅛in. long, ciliate; bracteoles lanceolate, hairy; corolla scarlet, 1¼ in. diam., tube 2 in. long, narrow at the base, broadening upwards, lip reflexed, 1¼ in. long; upper pair of petals hooded, lateral ones reduced to short obtuse lobes. Trop. S. Amer. B.M. 8272. Gt. 40: 1354.—The finest species in cult.; a magnificent stove plant.

nìtens, Hook. f. An erect herb or sub-shrub: st. terete, green, stout, usually dwarf and compact: lvs. shortly petiolate, ovate-acute, entire, thick, rich dark olive-green above, bright vinous purple below, highly glabrous on both sides, margins recurved; petiole very short or none, winged: infl. an erect terminal spike, 6 in. or more long; bracts green and erect, 1–1½ in. long, serrate; sepals ⅛in. long, linear-lanceolate; corolla bright vermilion-scarlet, 1–1½ in. diam.; lip ovate, larger than the rest of the petals and slightly reflexed; upper pair of petals hooded; tube 1–1¼ in. long, yellow. Colombia. B.M. 5741. Gn. 48:122.—A fine dwarf-growing stove plant readily prop. by cuttings and often setting seed if kept in a cooler and drier house when in flower.

fascinàtor, Lind. & André. Habit stiff and erect, with fls. opening in succession over a period of some 4–6 weeks: st. terete, green, glabrous: lvs. elliptic, lanceolate or ovate-lanceolate, acuminate, entire, shortly petiolate, 6–9 in. long, upper side dark green with narrow band of silvery white along midrib and principal veins, lower side dull wine-red with veins of a darker shade: infl. an erect unbranched terminal spike up to 6 in. long; bracts ovate or elliptic, basal ones an inch long, tapering upwards to ⅛in. long, covered with short pilose hairs; sepals ⅓in. long, lanceolate, glandular, green; corolla bright vermilion-scarlet, 1½ in. diam. with large and prominent front lobe; tube slender. 1½ in. long. B.M. 8398. I.H. 21:164.—A beautiful and striking species, well worth growing for its handsome foliage apart from its beautiful fls. It should be kept rather on the dry side as soon as the fls. appear, otherwise the plant is likely to lose all its roots.

A. atróvirens, N. E. Br. Dwarf: lvs. very dark green above and purplish beneath: fls. yellow, 1 in. long. Brazil. I.H. 31:527.—*A. liboniàna*, Lind. Dwarf: lvs. ovate and long-acuminate, with a white rib, green below: fls. deep yellow, small, scarcely exserted beyond the red bracts. Brazil. B.M. 5463.—*A. macedoniàna*, Lind. & Rod. Said to be a form of A. atrovirens. Lvs. with white rib and main veins. Brazil. I.H. 33:583.—*A. Márgaritæ*, E. Morr. Lvs. elliptic-acuminate, barred with white, purple below: fls. yellow, the bracts strong-toothed. Brazil. G.C. III. 2:585.—*A. orientàlis*, offered in Amer., is possibly a form of some well-known species.—*A. púmila*, Hook. f. Less than 1 ft.: lvs. large, acute: fls. orange, bracts purplish. Brazil. B.M. 6467.—*A. variegàta*, Morel. A near ally of A. Blanchetiana with bright scarlet bracts, and bright yellow fls. Probably not now in cult. B.M. 4899. F.S. 10:981.

L. H. B.
C. P. RAFFILL.

APHELÉXIS: *Helichrysum.*

APHÝLLON (Greek, *leafless*). *Orobanchàceæ*. Two species of small N. American parasitic herbs, now often united with Orobanche, and by others kept distinct under Rafinesque's name, Thalesia. These plants are not cult., but are always interesting to the collector and surprising to one who runs across them in woods or fields. **A. uniflòrum,** Gray, Fig. 231, produces very few leafless 1-fld. pale scapes, 3–8 in. high, and 5-lobed, curved, white or violet fls., and known as cancer-root. **A. fasciculàtum,** Torr. & Gray, has the scaly st. rising higher out of the ground and bearing several crowded peduncles: fls. purplish yellow. —These plants occur sparingly nearly or quite across the continent.

231. Aphyllon uniflorum. (×⅓)

APÌCRA (*not bitter*, from the Greek). *Liliàceæ*, tribe *Aloíneæ*. Aloe-like plants, grown with other succulents.

Shortly caulescent small succulents: lvs. spirally arranged or crowded along the st.: fls. greenish, often striped with white, straight, tubular or prismatic, with short, flat or spreading white limb surpassing the stamens. Cape region. —Agave house or cactus house; suitable for rockeries during the summer. Prop. like Aloe. Monogr. by Baker. G.C. II, 11:717 (1879). Journ. Linn. Soc. Bot. 18:216. Berger in Das Pflanzenreich 1908, hft. 33.

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A. *Lvs. warty on the back: fls. smooth.*

1. áspera, Haw. (*Alòe áspera*, Haw. *Hawórthia áspera*, Haw.). St. mostly simple, erect, 4–6 in. high, 1½ in. diam., including lvs.: lvs. half-globose, acuminate, slightly keeled, ⅝in. long, green, smooth on the rather convex upper surface, green-warty on the back, the margin granular: infl. scarcely 1 ft. high, unbranched; fls. somewhat rosy, ⅜in. long, twice as long as the pedicels. Cape. Salm, Aloe §2. f. 2.—A large form with white-warty lvs. twice as long, is var. **màjor,** Haw.

232. Apicra pentagona.

2. bicarinàta, Haw. (*Alòe bicarinàta*, Roem.). St. erect, 6–12 in. high: lvs. falcately short-ovate, acute, acutely keeled, ⅝ x ¾in., green, smooth on the somewhat concave upper surface, irregularly white-warty on the back, the margin and keel granular roughened. Cape. Berger 40.

3. bullulàta, Willd. (*A. pentagòna bullulàta*, Baker. *Alòe bullulàta*, Jacq.). St. erect: lvs. lanceolate, acute, obliquely keeled, ⅝ x 1¼ in., pale, the back unequally

white-warty, the margin and keel finely denticulate: fls. somewhat yellow. Cape.

AA. *Lvs. not warty.*

B. *Fls. warty: lvs. smooth.*

4. **spiràlis,** Baker (*A. imbricàta,* Willd. *Alòe spiràlis,* Linn. *A. imbricàta,* Haw. *A. cylíndrica,* Lam. *Hawórthia imbricàta,* Haw.). Sts. somewhat clustered,

233. Apios tuberosa. (×⅓)

erect, 6–12 in. high; about 2¼ in. diam., including lvs.: lvs. broadly triangular-acuminate, biconvex, ½ x 1¼–1½ in., glaucescent, the margin slightly granular: infl. about 1 ft. high, unbranched; fls. greenish, ½in. long, more than twice as long as the pedicels. Cape. DC., Pl. Gr. 56. Jacq., Fragm. 110. B.M. 1455. Salm, Aloe §1. f. 1. Dillenius, Eltham. 13. Commelin, Præl. 32.

BB. *Fls. smooth: lvs. sometimes granular in the first.*

5. **pentagòna,** Willd. (*Alòe pentagòna,* Haw. *Hawórthia pentagòna,* Haw.). Fig. 232. St. mostly solitary, erect, 6–12 in. high; about 4 in. diam., including lvs.: lvs. distinctly 5-ranked, broadly triangular-lanceolate, acute, biconvex, somewhat low-keeled, ¾ x 1½–2 in., green, slightly (sometimes granularly) white-dotted, the margin slightly granular: infl. 1½ ft. high, sometimes forked; fls. greenish, ⅜in. long, twice as long as the pedicels. Cape. Jacq., Fragm. 111. B.M. 1338. Salm, Aloe §1. f. 4. Berger 40.—Varies into forms with lvs. less obviously 5-ranked: large, in somewhat evident oblique ranks, var. **Willdenòwii,** Baker (*A. spiràlis.* Willd. *Alòe spiràlis,* Haw. *A. pentagòna spiràlis,* Salm-Dyck), Salm, Aloe §1. f. 5; smaller, scarcely in distinct ranks, var. **spirélla,** Baker (*Alòe spirélla,* Salm-Dyck. *Hawórthia spirélla,* Haw.), Salm, Aloe §1. f. 3.

6. **congésta,** Baker (*Alòe congèsta,* Salm-Dyck). St. solitary, erect, about 1 ft. high and 4 in. diam., including lvs.: lvs. broadly ovate, acuminate, rather flat above, more or less keeled, 1–1¼ x 1½ in., green, glossy, the margin granular: infl. 1¼ ft. high, simple; fls. greenish, nearly ⅝in. long, with rather large spreading segm.-tips, thrice as long as the pedicels. Cape. Salm, Aloe §2.f.

7. **deltoídea,** Baker (*Alòe deltoídea,* Hook.). Sts. somewhat clustered, 6 in. or more high, about 2¼ in. diam., including lvs.: lvs. distinctly 5-ranked, ovate, sub-acute, somewhat concave and low-keeled, 1 x 1¼–1½ in., green, glossy, the margin and keel serrulate: infl. 1 ft. high, simple; fls. nearly sessile, yellow-green, about ⅜in. long, the rather large spreading white segm.-tips at first rosy. Cape. B.M. 6071.—Varies in a form with more turgid lvs. less obviously 5-ranked, var. **túrgida,** Berger (*A. túrgida,* Baker), and a smaller form with evidently 5-ranked sometimes bluish lvs., var. **intermèdia,** Berger.

8. **foliolòsa,** Willd. (*Alòe foliolòsa,* Haw. *Hawórthia foliolòsa,* Haw.). Sts. somewhat clustered, erect, at length a foot or more high; 1⅛ in. diam., including lvs.: lvs. broadly ovate-acuminate, flat above, acutely keeled, ⅜–⅝in. long and wide, green, glossy, the margin granular: infl. over 1 ft. high, simple; fls. greenish, about ⅜in. long, twice as long as the pedicels. Cape. B.M. 1352. Salm, Aloe §2. f. 4. Berger 40.

234. Fruit of Apiectrum hyemale. Nearly natural size.

WILLIAM TRELEASE.

ÀPIOS (*pear,* from the Greek, alluding to the shape of the tubers). *Leguminòsæ.* Hardy twining herbs, with tuber-bearing roots, infrequently planted.

Leaves pinnate, of 3–9 mostly ovate-lanceolate scarcely stipellate lfts.: fls. in dense, short racemes, papilionaceous, the standard broad and reflexed, keel incurved and coiled; stamens 9 and 1: pod linear and flat, several-seeded.—Two species in E. N. Amer., and 3 others in Asia.

tuberòsa, Mœnch. GROUNDNUT. WILD BEAN. Fig. 233. Four to 8 ft., climbing over bushes: root bearing strings of edible tubers, 1–2 in. long: lfts. 5–7, ovate-lanceolate: fls fragrant, chocolate-brown, the standard very broad and turned back, the keel long, incurved and scythe-shaped. July, Aug.—Common in low grounds and swamps. The fr. often fails to mature. Prop. by the tubers, 2–4 of which should be planted together at a depth of 3–4 in.; also, by seeds. Grows well in the wild border, in any loose, rich soil. Under these conditions, the plant covers a trellis or other support in a comparatively short time. Dry tubers offered by seedsmen are likely to start slowly. The brown of the fls. is a very unusual color in hardy herbs. Likely to become a weed in rockeries and wild gardens.

A. Fórtunei, Maxim., is occasionally cult. in Japan for its small, ovate, edible tubers. A.G. 13:77.—*A. Pricèana*, Rob., native to Kentucky, may be expected to appear in the trade: root a single large tuber, becoming 6–7 in. diam.: fls. pale rose-color: a vigorous climber, first described in 1898 (Bot. Gaz. 25:451, with illus.).

ÀPIUM: *Celery.* L. H. B.

APLÉCTRUM (Greek, *with no spur*). *Orchidàceæ.* A small orchid, with smallish dull-colored fls. in a raceme, on a leafless scape, which springs from a large corm-like tuber. Single species (or possibly two), in woods in the northern states.

Flower spurless and sacless; petals and sepals similar, narrow; lip 3-lobed and crested, deflexed; fertile anther 1, the pollen-masses 4, smooth and waxy; column free, compressed, the anther borne below the top.

hyemàle, Nutt. (*A. spicàtum*, B. S. P.). PUTTY ROOT. ADAM-AND-EVE. Fig. 234. Sends up a pointed green lf. 2–6 in. long, which lasts through the winter, and in spring a stalk about a foot high, bearing a raceme of rather large greenish brown fls., which are succeeded by hanging, oblong-pointed pods (Fig. 234).—Hardy. May be grown in rich, loamy borders. Interesting, but not showy. L. H. B.

APLOPÁPPUS (Greek, *simple pappus*). Syn., *Haplopappus. Compósitæ.* Herbaceous perennials, sometimes offered for the hardy border.

Leaves mostly stiffish or rigid, alternate: heads radiate, many-fld., the rays pistillate; involucre hemispherical, with several series of closely imbricated bracts: pappus simple, of many unequal bristles, the achene short and narrow.—A genus of about 115 species of herbaceous perennials, rarely shrubs, mostly from Calif. and Chile. Fls. yellow, in summer and autumn. Separated only by technical characters from Bigelovia, into which it insensibly grades. (Bigelovia has discoid few-fld. heads and pappus in single row.) The only 3 species known to have been in the American trade are

lanuginòsus, Gray. Hardy alpine herb, woolly, 4 in. high, from creeping rootstocks: lvs. soft, narrowly spatulate, or upper linear, 1–2 in. long: rays 15–20. Mts. of Wash. and Mont.—Intro. 1889, by F. H. Horsford.

Párryi, Gray. Alpine herb, 6–18 in. high, green and almost glabrous: lvs. oblong-obovate, 2–4 in. long: fl.-heads about ½in. high, pale yellow, the involucral bracts oblong and obtuse; rays 12–20, small and narrow. —Suitable for rockwork.

crôceus, Gray. St. about 1½ ft., erect and stout, and with radical lvs. a foot or less long: cauline lvs. ovate-oblong to lanceolate, partly clasping: fls. showy, saffron-yellow, the rays about an inch long, the inner involucral bracts ragged. Rocky Mts. June–Oct.

A. ericoides, Hook. & Arn. Shrub, 2–5 ft. high: lvs. very numerous, filiform, those of the dense fascicles, 2 or 3 lines long: fls. very numerous. G.C.III. 20:301. N. TAYLOR.†

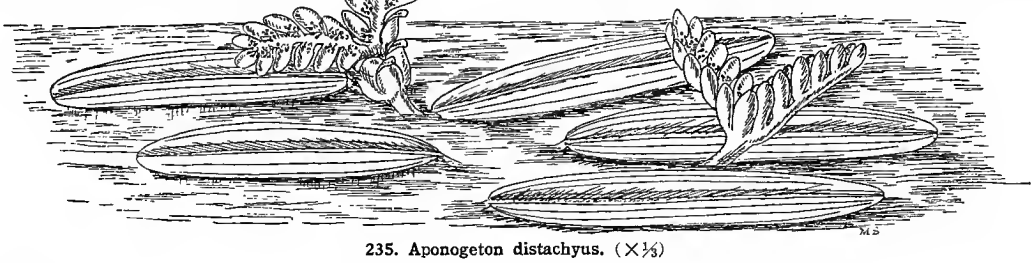
APÓCYNUM (Greek for *dog-bane*). *Apocynàceæ.* DOG-BANE. INDIAN HEMP. Native herbs, sometimes planted in borders.

Flowers small, the calyx with acute teeth; corolla bell-shaped, with 5 appendages inside; stamens 5, inserted deep in the corolla, the filaments very short; style 0: seeds silky.—Tough perennial herbs, with milky juice, chiefly of north temperate zone, with oblong or ovate, opposite lvs., milkweed-like fls. in small cymes, and slender follicles or pods. About 25 species, 10 native to N. Amer.

androsæmifòlium, Linn. SPREADING DOG-BANE. Three ft. or less high, usually glabrous, the branches spreading: lobes of corolla revolute and tube of corolla longer than the calyx: lvs. oval or ovate, mucronate, short-petioled: cymes loose, axillary and terminal; fls. bell-like, white or pink. N. N. Amer.; common. B.M. 280.—Sold by dealers in native plants. Useful for the hardy border as it will stand dry open places. Root used in medicine; sometimes gathered by drug-collectors for *A. cannabinum*, but as its action is different, it should not be substituted.

cannabìnum, Linn. Branches erect or nearly so: lobes of corolla nearly erect, the tube not longer than calyx: lvs. ovate to lance-oblong, short-petioled: cymes dense; fls. greenish white. Northern states; common.—Not known to be in the trade, but likely to be confounded with the above. Root emetic, cathartic, diaphoretic, expectorant, and diuretic. The tough fibrous bark of the stalks formerly used by the Indians for making twine. L. H. B.

APODOLÍRION (Greek combination, *footless lily*, the peduncles not being evident). *Amaryllidàceæ.* Greenhouse bulbs of S. Afr., of which one or two of the half-dozen species are rarely cult. Bulb tunicated: fl. 1, borne or hidden in the bulb-neck in the manner of crocus, white or reddish: lvs. usually not appearing with the fls., narrow. **A. Éttæ,** Baker, and **A. lanceolàtum,** Baker, are probably best known as cult. plants. The former has a white, tinged red fl. 3 in. long and crocus-like lvs.; the latter (*Gethýllis lanceolàta*, Linn. f.) has a much shorter fl., white or whitish, and a solitary lanceolate lf. appearing with the fls. The apodolirions are prop. by offsets or seeds.



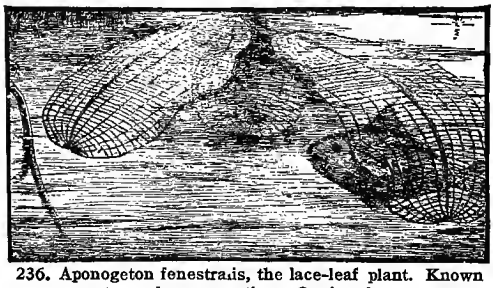
235. Aponogeton distachyus. (×⅓)

APONOGÈTON (Greek name, referring to its habitat in the water). *Aponogetonàceæ.* Aquatics, mostly with flat floating lvs. and emerging spikes of fls. Includes Ouvirandra.

Submerged herbs, with tuberous rhizomes and fibrous roots: lvs. long-stalked, oblong or linear, sometimes lacking the parenchyma and having a lattice-like character: fl.-characters those of the family (p. 13). —About two dozen species of warm countries, Asian, African and Australian. Krause & Engler, Das Pflanzenreich, hft. 24 (1906). There are two main species in cult., the aponogeton proper with solid lvs., and the ouvirandra with open-work lvs. The former is grown mostly out-of-doors; the latter in warm greenhouses.

distàchyus, Linn. f. CAPE POND-WEED. WATER HAWTHORN (from the fragrance). Fig 235. Fls. in twin spikes on the emersed ends of long scapes, wholly naked, but subtended by a double row of petal-like bracts, very fragrant, with purple anthers:

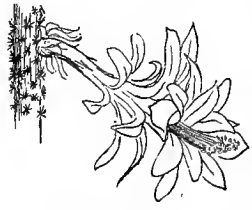
lf.-blade floating, oblong-lanceolate, round-based, parallel-veined, 3–6 in. long. Cape of Good Hope. B.M. 1293. F.R. 1:463. P.G. 4:106. G.W. 5:195. Gng. 2:25. —A charming and interesting plant. In a protected pool, especially if it can be covered in winter, the plant is hardy in the N., blooming nearly all summer. Removed to tubs in the fall, it blooms nearly all winter; or it can be grown permanently in tubs or deep pans in the house. Requires about 2 ft. of water, or out-of-doors it may have twice that depth. Prop. chiefly by seeds, but fls. should be pollinated and kept above water at least 24 hours afterward, and seeds not be allowed to become dry. Var. **Lagràngei**, Hort. (*A. Lagràngei*, Hort.), is a rare and beautiful variety, with violet bracts and lvs. violet beneath. It props. slowly. R.H. 1895:380.



236. Aponogeton fenestralis, the lace-leaf plant. Known to gardeners mostly as Ouvirandra.

fenestràlis, Hook. f. (*Ouvirándra fenestràlis*, Poir.). LACE-LEAF. LATTICE-LEAF. Fig. 236. Lvs. oblong, 6–18 in. long and 2–4 in. broad, reduced to skeletons, floating just under the surface of the water: fls. small, consisting of 6 stamens, 3 pistils and 2 white petal-like bodies, numerous, in 2 spikes each about 2 in. long, which are united at the base, and borne on the top of a scape a foot or so long. Madagascar. A.F. 7:67. A.G. 15:169. B.M. 4894. Gt. 1863:387. G.M. 38:830. Gn. 30, pp. 344, 345. Mn. 6, p. 231. F.S. 11:1107. I.H. 8:300. G.W. 10:595 (var. *major*).—The lvs. are merely a tracery of nerves and cross-veins, but despite their lace-like delicacy they can be handled with considerable roughness. The venation of the lace-leaf plant is like that of the common aponogeton, and now and then a lf. occurs in which the spaces between the veins are partly or wholly filled with green matter. There is another species with skeletonized lvs. (*A. Bernierianus*), but the open spaces are smaller and the plant is less desirable for cult.

The lace-leaf plant can be grown in a tub in a warm greenhouse. For some unknown reason the plant seems rarely to succeed in a jar or glass aquarium. Some cultivators think that the water must be changed every day, but this is not necessary. If confervæ appear, introduce a few tadpoles and snails; these will devour the green scum, and help to keep the plant in good health by furnishing oxygen. See *Aquarium*. The plant should be potted, and plunged not more than 18 in. below the surface of the water. For potting soil use a rich compost, such as is recommended for water-lilies. The water should be kept clean and sweet, and a temperature of 65–70° provided. Avoid direct sunlight. In Madagascar the streams often dry up, and the tubers carry the plant over the dry season. In imitation of nature some cultivators take the tubers out of the soil, and leave them on a shelf in a hothouse during the month of Feb. It is doubtful whether this is necessary. Potting should be done while the plant is in active growth, not dormant. Prop. by division. The lace-leaf is cult. in all the finest collections of aquatics, and is prized as a curiosity.



237. Aporocactus flagelliformis. (×½)

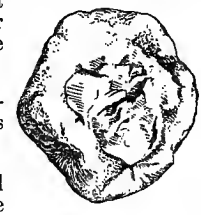
A. angustifòlius, Ait. (A. capensis, Perry). Like A. distachyus, but much smaller: fls. small, white. S. Afr.—*A. Bernierianus*, Hook. f., differs from A. fenestralis in having smaller open spaces in the lvs., and pinkish 4-parted spikes.—*A. Dinteri*, Engl. & Kr. Tuber globose: floating lvs. oblong, rounded or somewhat emarginate at base, long-nerved, not lace-like: inflorescence 2-spiked, yellowish. German S. W. Afr. G.W. 14:659.—*A. Henkelianus*, Hort. Allied to A. fenestralis, but rhizome larger and not creeping: lvs. pale green, less lasting. Madagascar. G.C. III. 40:270.—*A. monostachyus*, Linn. f. (A. natans, Engl. & Kr.) Lf. linear-oblong infl. in 1 spike, pink. India, Asatral. G.W. 9:62.

L. H. B.
WM. TRICKER.

APOROCÁCTUS (Greek, *impenetrable* and *cactus*). *Cactàceæ*. A very slender vine-like creeping, clambering, or hanging cactus, sending out aërial roots: fls. rather small, slender, somewhat irregular, bright red: fr. small, globose, reddish, setose.—Three species recognized, the one below and *A. flagriformis*, Lem., and *A. leptophis*, Britt. & Rose. Only one appears to be in cult. These plants are commonly referred to Cereus.

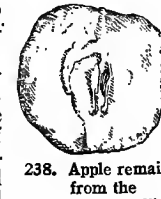
flagellifórmis, Lem. (*Cèreus flagellifórmis*, Mill.). RAT-TAIL CACTUS. Fig. 237. Sts. about ½in. diam., branching: ribs 10–12: fls. 2–3 in. long. Trop. Amer.—This is commonly hybridized with other species. It is a well-known window-plant. It is easily grown and is a great favorite with people who know little about cacti. It is often grafted on other cacti and worked into various fantastic designs. It is rather a free bloomer, and with proper care a most charming plant can be obtained.

J. N. ROSE.



APOSÈRIS. An alpine composite, now included in the genus *Hyoseris*, which see.

APPLE. *Rosàceæ*. The fruit and tree of *Pyrus Malus*, one of the rosaceous group. The name is also applied, with qualifications, to many other edible fruits, as may-apple, pond-apple, rose-apple.



238. Apple remains from the Swiss lake dwellings.

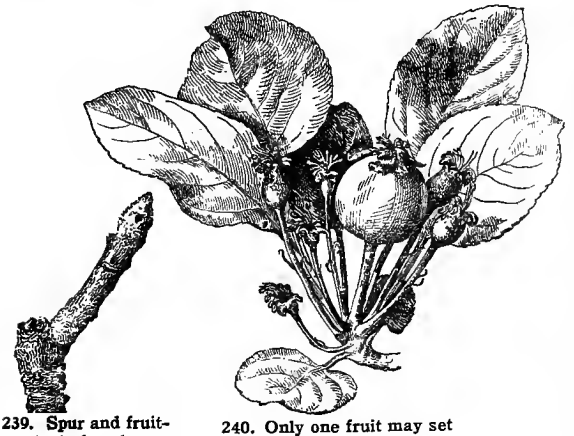
The apple is native to southwestern Asia and adjacent Europe. It has been cultivated from time immemorial. Charred remains of the fruit are found in the prehistoric lake dwellings of Switzerland (Fig. 238). Now widely cultivated and immensely variable, the apple is grown in every temperate climate, and is probably the most important commercial pomological fruit.

The apple has come apparently from two original stems. All the common apples are modifications of *Pyrus Malus* (see *Pyrus*), a low round-headed tree, with thick and fuzzy irregularly dentate, short-stemmed leaves and fairly compact clusters of woolly-stemmed flowers. The crab-apples are derived chiefly from *Pyrus baccata*, commonly known as the Siberian crab. This species is probably of more northern or eastern origin than the other. It is of smoother and more wiry growth, with narrower and thinner essentially glabrous long-stemmed leaves, and more open clusters of glabrous-stemmed flowers. The apple is small and hard, and the calyx-lobes fall at maturity, leaving the eye or basin of the fruit smooth and plain. Hybrids between these species apparently have given the race of large-fruited crab-apples, of which the Transcendent and Hyslop are examples. The race known to pomologists as *Pyrus prunifolia* is perhaps a hybrid group. Certain apples are native to North America. Two species, *Pyrus ioensis* and *P. coronaria*, are of interest to the pomologist. The former is the prairie-states crab, and is the more promising. In characters of growth, leaves

VII. The flowers of the apple tree.

and flowers, it bears a striking resemblance to forms of *Pyrus Malus*. The fruit is spherical or spherical-oblong, short-stemmed, very hard, and remains green-colored. The fruit of the eastern-states crab, *Pyrus coronaria*, is distinctly flattened endwise, and is long-stemmed. The leaves are deep-cut and often three-lobed. There are no improved varieties of this eastern species, and no authentic hybrids between it and the common apples. The fruit is sometimes used by settlers, but it has little comestible value. *Pyrus ioensis* has produced a number of promising hybrids with the common apple, and this mongrel race is known as *Pyrus Soulardii*. The Soulard crab is the best known of these. Its value lies only in its extreme hardiness. The pomological value of the native crabs is prospective. For a completer account of the native apples, see Bailey, "Evolution of our Native Fruits."

One of the most perfect apple regions of this country—considering productiveness, quality, long-keeping attributes, longevity of tree—is that which begins with Nova Scotia and extends to the west and southwest to Lake Michigan. Other important regions are the Piedmont country of Virginia and the highlands of of adjacent states; the Plains regions; the Ozark and



239. Spur and fruit-bud of apple.

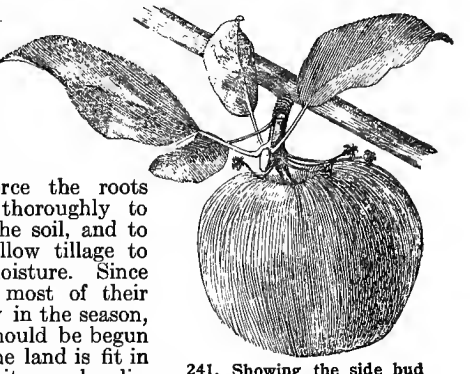
240. Only one fruit may set in a cluster.

Arkansas region; the intermountain region from Montana to New Mexico; the Northwest, including both large and small areas in British Columbia, Washington and Oregon; and the Pacific region, comprising the foothills and parts of the coast in California. All parts of the United States north of Florida and the Gulf borders, and excluding the warm-temperate parts of the Southwest, are adapted to the apple in greater or lesser degree. North America is the leading apple-growing country of the world. A full crop for the United States and Canada, of all kinds and grades, is probably not much less than 100,000,000 barrels, although it is doubtful whether more than one-third of this vast quantity is marketed in a fresh state. The apple is a cosmopolitan fruit, and, since it thrives almost anywhere, it is commonly neglected.

The apple was early introduced into this country. In the first days it was prized chiefly for cider. It is an ancient and common notion that any apple is good enough for cider; and this is one reason for the neglect in which the apple plantation was commonly allowed to stand.

Brief or summary statement.

The best results in apple-growing are to be expected in general when the land is tilled. The reasons for tilling the orchard are those that apply to other crops,—to make plant-food available, to extend the area in which the roots can grow, to conserve moisture. It is especially important, in our hot and sunny country, that the roots extend deep enough to escape the disastrous effects of drought. The ideal treatment of orchard land is to fit the ground deep before the trees are planted, to plow deep for a year or two or three in order to force the roots down and thoroughly to ameliorate the soil, and to practise shallow tillage to conserve moisture. Since trees make most of their growth early in the season, the tillage should be begun as soon as the land is fit in spring; and it may be discontinued by midsummer or August. This cessation of the tillage allows of the growing of some cover-crop or catch-crop late in the season, in order to provide humus and to improve the physical texture of the soil. If the land is well handled in the first few years, it will not be necessary to turn a furrow in the orchard frequently thereafter, but merely to loosen the surface in the spring with a spading-harrow, spring-tooth harrow, or other tool, to reëstablish the surface mulch. The only reasons for turning a furrow will occur when the land is so hard that the surface tools cannot mellow the surface, or when it is desirable to turn under a green-manure crop. Even hard lands may be got in such condition, by means of tillage and green-manures, that they may be worked up with harrow tools when the orchard comes into bearing. Plowing the orchard, therefore, has two legitimate objects: to mellow and ameliorate the land to a considerable depth, so that the roots may forage deep; to turn under a cover-crop. The former purpose should not be necessary after the first few plowings. An incidental object of plowing is to facilitate the making of the annual surface mulch; and this mulch is to save the moisture.



241. Showing the side bud that is to continue the spur the following year.

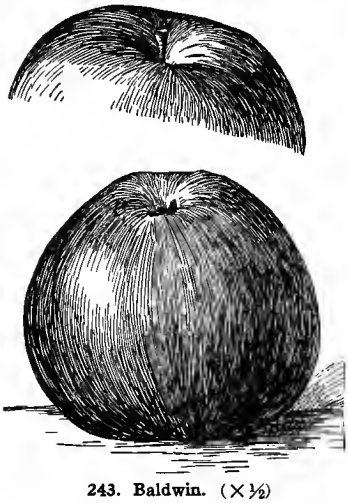
On good lands in which there is a sufficient natural supply of moisture, the sod-mulch treatment may take

242. The flower-cluster and the leaf-cluster.

the place of tillage. This procedure keeps the land in sod, and the grass is mown and allowed to remain on the ground or is spread under the trees.

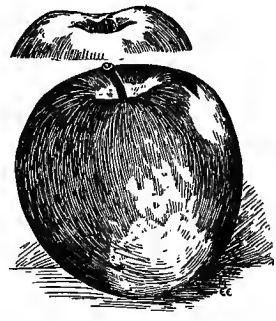
The apple thrives in a variety of soils. Lands that yield good crops of wheat and corn may be expected to be good apple lands, if other conditions are right. Rolling, inclined, or somewhat elevated lands are generally considered to be most desirable. Their value lies in the better drainage of water and air. The trees may be set in either fall or spring. Forty feet apart each way is the standard distance for apple trees; but some varieties, as the Wagener and the crabs, may be set closer. In the South and on the plains, trees may

be set closer, as they do not attain such great size as in the northeastern states. In general, it is best to devote the land to apples alone; but persons who are willing to give the plantation the best of care may plant other trees between the apples as fillers. The more diverse the kinds of trees which are planted together, the more difficult it is to give the proper care to each. Some of the shorter-lived varieties of apples make excellent fillers in the apple orchard; and in special cases dwarf apples may be used.



243. Baldwin. (×½)

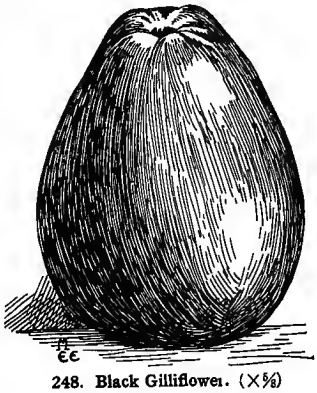
Although it should be the general purpose to till the apple orchard throughout its life, whenever the trees seem to be growing too rapidly, the plantation may be seeded down for a time. That is, tillage is the general practice; seeding down and sod-mulching are the special practices. For the first few years, annual crops may be grown in the apple orchard; but every year a more open space should be left about the trees. As often as the land becomes crusted it should be tilled. On strong lands which are well handled, it is rarely necessary to apply concentrated fertilizers until the trees are old enough to bear. What fertilizers are then needed, and how much to apply, are to be determined by the behavior of the trees. If the trees are making insufficient growth, and the foliage lacks color, one or all of three things may be the trouble: the trees may need water; they may be suffering from insects or disease; they may lack nitrogen. If it is thought that they lack nitrogen, this material may be supplied in the form of nitrate of soda, sulfate of ammonia, or the unburned animal substances, as blood and tankage. Two to three hundred pounds to the acre of the nitrate of soda or sulfate of ammonia are liberal applications on well-tilled lands. If the trees are making vigorous growth, the probability is that they are not in need of more nitrogen. Potash and phosphoric acid may then be applied. Three hundred pounds of muriate of potash, or other concentrated material, should be sufficient for an acre, under ordinary conditions. As a rule, all orchards in full bearing should have a liberal annual application of fertilizing materials. In the East, apple trees should be in profitable bearing at twelve years from planting, and should continue for thirty years. In recent years, lime has been applied in many cases with good results, about 1,000 pounds to the acre every four or five years.



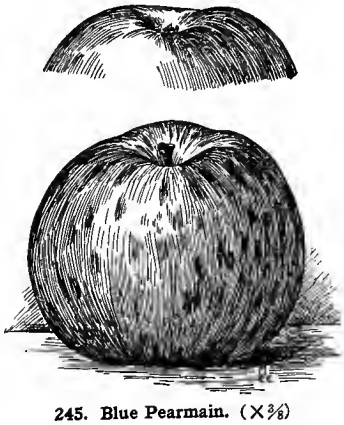
247. Gano. (×⅜)

244. Ben Davis. (×⅜)

The two staple enemies of the apple are the apple-worm (the larva of the codlin-moth), and the apple-scab. These are readily held in check by spraying,—with arsenical poisons for the worm, and with lime-sulfur or bordeaux mixture for the scab. See *Spraying*. Spraying for the worm should be performed as soon as the last petals fall; for the scab as soon as the buds are well burst. In badly infected regions and on very susceptible varieties, it may be necessary to spray first

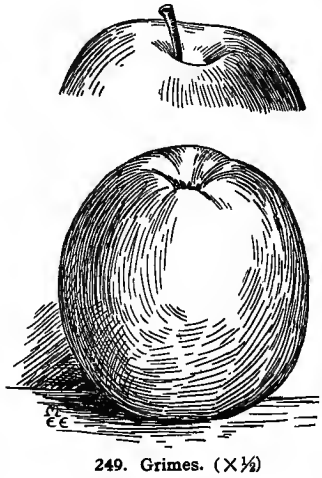


248. Black Gilliflower. (×⅝)



245. Blue Pearmain. (×⅜)

246. Esopus (Spitzenberg). (×⅜)

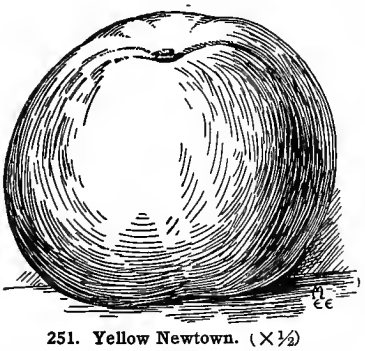


249. Grimes. (×½)

for the scab before the buds swell. Since there are insects (as canker-worms, case-bearers, bud-moth) that appear before the flowers open, it is advisable to add arsenical poison to the fungicide at the early spraying. The number of times to spray depends on the thoroughness of the work, the pests to be combated, and the season; but it is a good rule to expect to spray with the combined fungicide and insecticide mixture when the buds burst, and again when the petals have fallen. In the plains country, less spraying may be necessary for the fungous diseases.

250. Hubbardston. (×⅜)

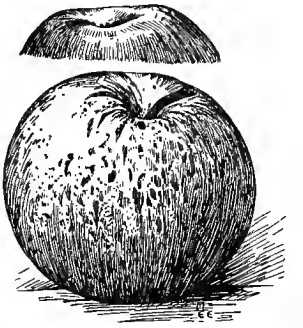
The apple commonly bears on spurs. The fruit-bud is distinguished by its greater size (usually somewhat thicker than its branch), its greater width in proportion to its length, and more conspicuous pubescence. It is also distinguished by its position. A fruit-bud is shown in Fig. 239. A fruit-scar is shown near the base of the branch. If this fruit was borne in 1912, the side branch grew in 1913 from a bud which came into existence in 1912. If we go back to the spring of 1912, the matter can be made plain. A cluster of flowers appeared. One flower set a fruit (Fig. 240). This apple is at the end of the branchlet or spur. The spur cannot increase in length in the same axis. Therefore, a bud appears on the side (Fig. 241). The fruit absorbs the energies of the spur. There is little nourishment left for the bud. The bud awaits its opportunity; the following year it grows into a branchlet and makes a fruit-bud at its end (Fig. 239); and thereby there arises an alternation in fruit-bearing, although not all alternating in fruit-bearing may be attributed to this cause. The difference between fruit-buds and leaf-buds becomes apparent when the buds burst (Fig. 242).



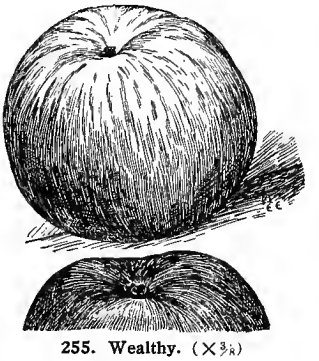
251. Yellow Newtown. (×½)

The apple is budded or root-grafted on common apple seedlings. These seedlings are usually grown from seeds secured from cider mills. In the East, budded trees are preferred. In the upper Mississippi Valley, root-grafted trees are preferred, largely because own-rooted trees of known hardiness can be secured. In Russia, seedlings of *Pyrus baccata* are used as stocks. They prevent root-killing, and give earlier fruit-bearing. Apple trees are usually planted when two or three years old.

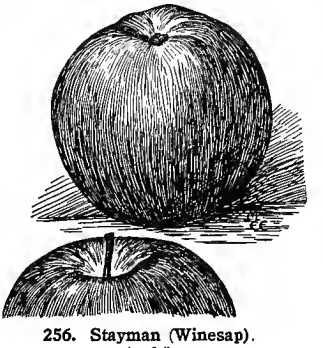
Apples are dwarfed by working them on various kinds of Paradise and Doucin stocks. These stocks are merely naturally dwarf forms of the common apple, and which, in some remote time, have originated probably from seeds. Dwarf apples are much grown in Europe, where small-area cultivation and wall-training are



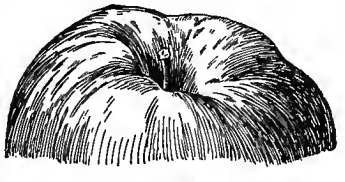
254. Rome Beauty. (×⅜)



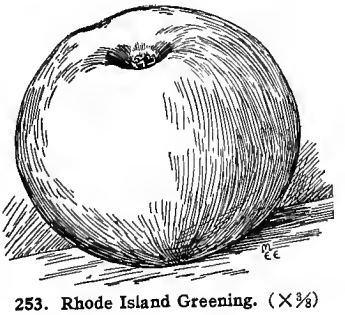
255. Wealthy. (×⅜)



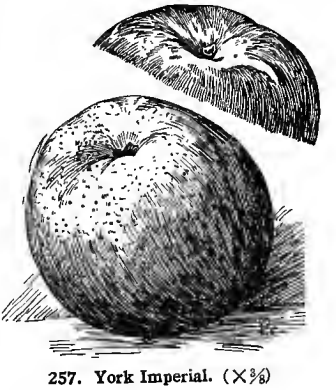
256. Stayman (Winesap). (×⅜)



252. Northern Spy. (×⅜)

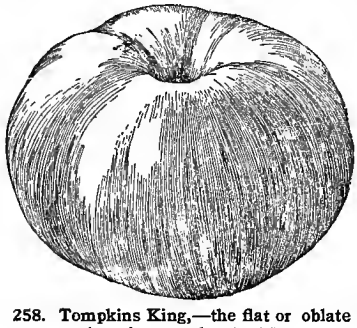


253. Rhode Island Greening. (×⅜)



257. York Imperial. (×⅜)

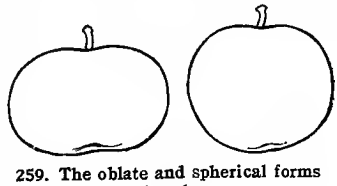
common, but they are little known in America, and, because of economic conditions, are usually not profitable here. See *Dwarfing*.



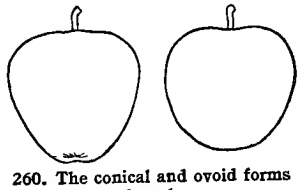
258. Tompkins King,—the flat or oblate American apple. (×½)

Varieties.

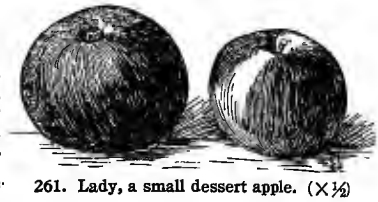
The varieties of apple trees actually on sale in North America in any year are not far from 1,000 kinds. Each great geographical area has varieties that are particularly adapted to it. In the northern Mississippi Valley, there are few of the eastern-states apples that thrive. Varieties have been introduced from Russia with the expectation that they will be adapted to the region; but more is to be expected of their progeny than of themselves. Varieties of local origin, coming from various stem types, are now providing that region with satisfactory apples. In the selection of varieties, one should be guided by this adaptation to the region, and by the purpose for which the fruit is designed to be grown. Consult the recommended lists of the state horticultural societies; ask persons who have had experience in the given region; write to the experiment station; enquire at the markets. The leading commercial varieties in North America are Golden Russet (N. Y.), Red Astrachan, Baldwin (Fig. 243), Ben Davis (Fig. 244), Blue Pearmain (Fig. 245), Oldenburg (Duchess of), Esopus (Spitzenberg) (Fig. 246), Fameuse, Gano (Fig. 247), Black Gilliflower (Fig. 248), Gravenstein, Grimes (Fig. 249), Hubbardston (Fig. 250), Ralls, Jonathan, Tompkins King, McIntosh, Missouri (Pippin), Newtown (Albemarle) (Fig. 251), Northern Spy (Fig. 252), Peck (Pleasant), Pennock, Rhode Island Greening (Fig. 253), Rome Beauty (Fig. 254), Shockley, Twenty Ounce, Wealthy (Fig. 255), Willow (Twig), Winesap and Stayman Winesap (Fig. 256), Wolf River, Yellow Bellflower, York Imperial (Fig. 257), King (Fig. 258). Baldwin and Ben Davis, the former of secondary quality and the latter of worse, hold the supremacy in American market apples. The apples of the eastern and central country tend toward flattened or oblate shape (Figs. 258–9). The typical form of the so-called long or conical American apple may be seen in Fig. 260. Many odd and unusual varieties are grown for dessert, one of which is shown in Fig. 261.



259. The oblate and spherical forms of apple.



260. The conical and ovoid forms of apple.



261. Lady, a small dessert apple. (×½)

Monuments or markers have been erected to a few of the most noted varieties of apples. Fig. 262 shows the monument erected in Wilmington, near Lowell, Mass., in 1895, to the Baldwin, with the following inscription:

THIS PILLAR ERECTED IN 1895
BY THE
RUMFORD HISTORICAL ASSOCIATION
Incorporated April 28, 1877
Marks the estate where in 1793 Samuel Thompson, Esq., while locating the line of the Middlesex Canal, discovered the first Pecker apple tree. Later named the
BALDWIN

The first tablet in New York state in memory of any apple was erected in the town of Camillus, Onondaga County, on the original site of the Primate apple tree (Fig. 263). John T. Roberts, Syracuse, N. Y., on September 11, 1903, caused a bronze tablet to be erected there. On this tablet is the following inscription:

On this farm Calvin D. Bingham, about 1840, produced the marvellous
PRIMATE APPLE
Named by Charles P. Cowles
GOD'S EARTH IS FULL OF LOVE TO MAN

A second marker was erected in New York in 1912 to the Northern Spy, Early Joe and Melon apples, at Bloomfield, by the Ontario County Fruit-Growers' Society (Fig. 264), with the following tablet:

262. Monument to the Baldwin apple.

263. Tablet to the Primate apple.

264. Northern Spy monument. (4 ft. high.)

THE ORIGINAL NORTHERN SPY APPLE TREE

stood about 14 rods south of this spot, in a seedling orchard planted by Heman Chapin about 1800.

THE EARLY JOE AND MELON APPLES
ALSO ORIGINATED IN THIS ORCHARD

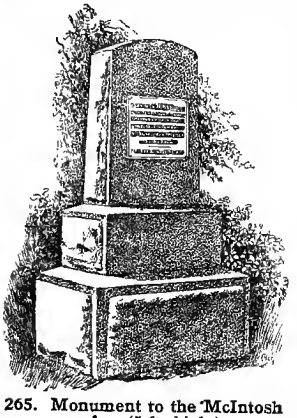
The McIntosh apple (McIntosh Red) is commemorated (Fig. 265) by a monument at Dundela, Dundas County, Ontario, as follows:

THE ORIGINAL McINTOSH RED APPLE TREE

stood about 20 rods north of this spot. It was one of a number of seedlings taken from the border of the clearings and transplanted by John McIntosh in the year 1796.

ERECTED BY POPULAR SUBSCRIPTION 1912.

The history is that John McIntosh came to Canada with the United Empire Loyalists. After spending some time along the frontier, he settled on his homestead in the county of Dundas in 1790 at a place later called McIntosh's Corners, although that place has now become extinct and Dundela has taken its place. In the year 1796 while clearing some forest land, he came upon a clump of young apple trees, about twenty in number. As apples were at that time a luxury, the apple trees were left unharmed, and a few days after were replanted in a clearing nearer his house. Most of the trees thrived for a few years but finally died. In 1830 only one tree out of the twenty remained. As this apple was unnamed, Mr. McIntosh combined his own name with the color of the apple and christened it "McIntosh Red." From the time it was transplanted, it grew rapidly and in a few years bore an abundance of fruit the color and flavor of which attracted the attention of the earlier settlers. It was situated about fifteen feet from the house, and when in 1893 the house was burned, the tree also received its share of the fire and one side was badly burned. Nevertheless, the other side continued to bear until 1908. That summer the leaves began to wilt and the apples to fall off until it was entirely bare. Thus the old tree which had withstood the storm of 112 years was forced at last to submit to the injuries received from the fire of 1893 (Fig. 266). The wide circulation of the McIntosh apple is due to his son, the late Allen McIntosh, who, fully appreciating the fruit, wished others to enjoy it also and started propagating by grafting and budding from the original tree. This has been repeated year after year since 1836.



265. Monument to the McIntosh apple. (5 ft. high.)

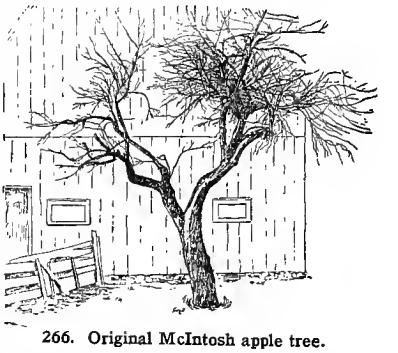
The origin of the Wealthy apple, the leading variety of the upper Mississippi Valley, is commemorated on the monument erected to the memory of Peter M. Gideon, Excelsior, Minnesota (Fig. 267). The tablet was unveiled and dedicated with appropriate ceremonies on the old farmstead, where he passed the last forty-six years of his life, at 2 o'clock on the afternoon of Saturday, June 15, 1912. The memorial consists of a block of granite, raised on a platform of solid concrete, surrounded by a chain supported by a number of black iron posts. On the sloping top of stone is a bronze tablet bearing this inscription:

This Tablet commemorates Peter M. Gideon
who grew the original

WEALTHY APPLE TREE

from seed on this, his homestead, in 1864.
Erected by the Native Sons of Minnesota, June, 1912.

The triangular piece of ground on which this is placed containing approximately a half-acre, is surrounded by a chain and post fence. This ground, the gift of O. P. Briggs, is dedicated as "Gideon Memorial Park." It lies on the main traveled boulevard between Excelsior and Minnetonka Beach, a few hundred feet south of the Manitou station on the electric line.



266. Original McIntosh apple tree.

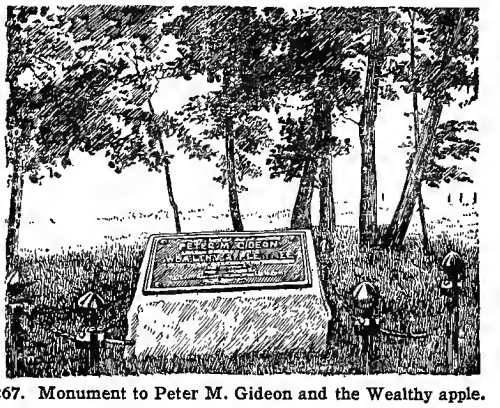
Special literature.

Several books devoted wholly to the apple have appeared in North America: Warder, Apples, 1867; Todd, Apple Culturist, 1871; Waugh, The American Apple Orchard, 1908; Burritt, Apple Growing, 1912; Woolverton, Canadian Apple Grower's Guide. For varieties, the two volumes, Beach, Apples of New York, published by the New York Agricultural Experiment Station, at Geneva, are invaluable. Consult, also, Vol. 25, Nebraska State Horticultural Society, 1894; The Apple, a report of the Kansas State Horticultural Society, 1898. Nearly all the fruit manuals devote space to the apple.

L. H. B.

Apple-growing in the northeastern states.

Although the eastern region (New England, New York, Pennsylvania) early developed an apple industry, it had few commercial orchards until near the middle of the last century. About that time many named varieties of American origin were disseminated. At first the product was used largely for the making of cider. Gradually there arose a demand for fresh fruit,



267. Monument to Peter M. Gideon and the Wealthy apple.

and as transportation facilities improved and the business became more profitable, there was a rapid increase in the number and size of the orchards. The production of apples increased more rapidly than the facilities for distribution and soon the supply apparently exceeded the demand. The low prices received in the following years discouraged the growers from further planting. Many growers, being attracted by the

alluring settlement of the West and others by the opportunities in the rapidly growing manufacturing centers, forsook their orchards. Of those who remained, many cut down the trees to make room for more profitable crops. The orchards that remained were mostly neglected and many of them may still be found, although few of them are now profitable. There have been two or three attempts at reviving the industry and these mark well-defined epochs of orchard planting.

With the phenomenal amassing of population in the eastern cities and with the marked improvement in transportation facilities, there has developed within the past ten years a remarkable opportunity in the growing of apples. As a result, enormous areas are being planted and many of the old and neglected orchards are being revived. Many persons from the cities are being attracted to the cheap lands in the East and most of them are planting apple trees. It is difficult to ascertain, even in an approximate way, the number of trees being planted in any section. The thirteenth census shows that there are over 7,425,000 apple trees in the eight states under discussion that had not reached the bearing age in 1910, and there has been much greater activity in tree-planting in the three subsequent seasons than ever before. Many of the old orchards, however, are fast passing out of existence. From the census reports it may be seen that despite the number of young orchards coming into bearing in the ten-year period, there were 10,488,000 more trees of the bearing age reported in 1900 than in 1910.

The question of the probability of over-production immediately arises. Most of the growers are still optimistic, thinking that for various reasons many of the orchards will never reach the bearing age and that with the rapidly growing population, the increasing opportunities for exporting, the raising of varieties of better quality, and with better methods of grading and packing, the supply will not exceed the demand for any considerable time.

Apple regions.

It is remarkable that the apple industry has reached its highest development in certain restricted regions. When pomologists speak of the western New York fruit-belt or the Champlain Valley district, a fairly definite area is understood. Usually such districts are marked by exceptionally favorable soil or climatic conditions. The conspicuous apple regions of the Northeast, although frequently hundreds of miles apart, possess about the same set of conditions. This is especially true within the same parallels of latitude. The distinctive features of these regions are:

(1) A favorable climate, that insures protection from extreme temperature, affords sufficient rainfall in summer, and that furnishes long days and abundant sunshine throughout the growing season.

(2) A favorable soil, that insures good drainage, ease of cultivation, and a spacious feeding-ground for the roots.

(3) A suitable topography, that affords adequate atmospheric drainage and insures protection from frosts and freezes. Lands adjacent to large bodies of water, however, are not necessarily dependent upon variations in altitude to insure protection from frost.

While favorable soil, climate and topography often are determining factors and are considerations of great importance, there is now known to be much greater latitude in this respect than was generally considered. In recent years, apples have been successfully and profitably grown under conditions that formerly were thought to be very undesirable. This is mentioned here to show that the proper selection of varieties and the adoption of special methods of treatment are also important factors, and that the "fruit-belt" is not the only controlling factor.

The accompanying table gives some information regarding the number of apple trees and the production of apples in the states under consideration. One column also shows the relation of the production of the various states to the total production of the United States:

VARIOUS APPLE STATISTICS FOR THE NORTHEASTERN STATES, ACCORDING TO THE CENSUS REPORTS FOR 1900 AND 1910.

State	Bushels 1899	Bushels 1909	Per cent of total production of U. S. 1909	Trees of hearing age		Trees not of hearing age 1910
				1900	1910	
Maine	1,422,000	3,636,000	2.48	4,185,000	3,477,000	1,045,000
N. Hampshire	1,979,000	1,108,000	.08	2,034,000	1,241,000	207,000
Vermont	1,177,000	1,460,000	.10	1,675,000	1,184,000	220,000
Massachusetts	3,023,000	2,550,000	1.73	1,852,000	1,367,000	356,000
Rhode Island	339,000	213,000	.01	214,000	152,000	55,000
Connecticut	3,709,000	1,541,000	1.04	1,167,000	799,000	212,000
New York	24,111,000	25,409,000	17.22	15,055,000	11,248,000	2,829,000
Pennsylvania	4,641,000	11,048,000	7.49	11,774,000	8,000,000	2,501,000
Total	40,401,000	46,965,000	31.83	37,956,000	27,468,000	7,425,000

By comparing the production from the various counties, it is easy to determine the conspicuous apple sections. The following table shows the production from the twenty-four highest producing counties in the northeastern states:

TABLE SHOWING PRODUCTION OF APPLES FROM THE TWENTY-FOUR HIGHEST PRODUCING COUNTIES IN THE NORTHEASTERN STATES, CENSUS OF 1910.

County	State	Bushels
Wayne	New York	3,304,000
Monroe	New York	2,592,000
Niagara	New York	2,367,000
Orleans	New York	2,229,000
Ontario	New York	913,000
Columbia	New York	893,000
Dutchess	New York	795,000
Ulster	New York	668,000
Chautauqua	New York	646,000
Middlesex	Massachusetts	633,000
Greene	New York	630,000
Wyoming	New York	625,000
Erie	New York	623,000
Worcester	Massachusetts	595,000
Genesee	New York	581,000
Cattaraugus	New York	558,000
Albany	New York	528,000
Cayuga	New York	484,000
Oxford	Maine	443,000
Berks	Pennsylvania	426,000
Oswego	New York	406,000
Tioga	Pennsylvania	399,000
Kennebec	Maine	392,000
Franklin	Maine	389,000

It will be seen that of the twenty-four counties, seventeen are in New York state, three in Maine and two each in Massachusetts and Pennsylvania.

The territory under consideration lies mostly between the 68th and 81st degrees of longitude and the 40th and 46th degrees of latitude. It possesses, on the whole, a very irregular topography, resulting from glacial deposits. It is drained in almost all directions by rivers of various sizes. It includes many fertile valleys, elevated plateaus, and several mountainous areas. Along

the coast in many sections, and on the shores of the Great Lakes are fairly broad low-lying plateaus. These areas, with the broad river valleys and their bordering slopes, are of great importance from a fruit-growing standpoint.

In a rough way, the lands may be divided into two main groups. The first embraces the river valleys, including the valley slopes, and the lower plains adjacent to the Great Lakes, and certain areas near the coast. To this group belong the most conspicuous apple-growing areas, such as those along the valleys of the Connecticut, the Hudson, the St. Lawrence, the Mohawk, the Susquehanna and other smaller rivers, and the shores of Lake Erie, Lake Ontario, Lake Champlain and various inland lakes.

The second group of lands embraces the uplands, composed usually of more or less rolling land with innumerable hills, narrow valleys, and great plateaus. This territory embraces much rough mountainous land that is of little value except for forestry. In general, the upland territory is devoted mainly to diversified farming. As a rule, only the hardier varieties of apples are grown, but in the uplands there are innumerable areas of restricted dimensions that are well adapted to the growing of apples in conjunction with other interests.

In the East apples are extensively grown for home use and for local market. For this reason the apple industry is not so centralized as it is in some other regions, although there are many large commercial orchards. Many individual orchards are small, being on diversified farms. According to the thirteenth census, the average value of farm lands throughout the eight states is $23.28 per acre. The price recorded for the states of Pennsylvania, New York, Massachusetts, Connecticut and Rhode Island was about the same, averaging $33.92 per acre, while that for the remaining three states, Maine, New Hampshire and Vermont was much lower, averaging $13.31 per acre.

The apple-growing area in the northeastern states is rapidly extending and comprises much of the cheaper lands of the territory. In New England, the area embraces the southern half of Maine, New Hampshire, and Vermont, projecting somewhat northward along the western border of the latter state, and extending southward to include the greater part of Massachusetts, Connecticut, and Rhode Island. Here the leading varieties in the older orchards are Baldwin, Rhode Island Greening, Northern Spy, Roxbury, Ben Davis, Fameuse, Tolman, Hubbardston, Oldenburg, Red Astrachan, Bethel, Twenty Ounce, McIntosh, Yellow Bellflower, and Wealthy. The later plantings are mostly of higher quality varieties, including Northern Spy, McIntosh, Wealthy, Fall Pippin, Sutton, Wagener, Red Canada, Esopus (Spitzenberg), Gravenstein, Yellow Transparent, Red Astrachan, Fameuse, Tompkins King, and Williams. The Baldwin, however, continues to be the most popular variety in New England.

In New York, the main apple-growing section extends along the south shore of Lake Ontario, but the industry is rapidly developing in many other parts, including the Hudson, Champlain, St. Lawrence, and lower Mohawk valleys, and the lands surrounding the central lakes. The leading varieties in the bearing orchards are Baldwin, Rhode Island, Northern Spy, Tompkins King, Roxbury, Hubbardston, Esopus (Spitzenberg), Golden Russett, Ben Davis, Tolman, Black Gilliflower, Twenty Ounce, Swaar, Westfield, Pumpkin Sweet, Fameuse, Fall Pippin, Yellow Bellflower, McIntosh, Wealthy, Oldenburg, Red Astrachan, Jonathan, Yellow Newtown, Green Newtown, Maiden Blush, Gravenstein, Blue Pearmain, Early Harvest, Alexander, and Yellow Transparent. Many of these varieties are still being planted, but the tendency is to set fewer varieties and more of the leading commercial sorts.

The apple-growing area in Pennsylvania is limited largely to the southeastern part of the state. The industry has reached its highest development in the Cumberland Valley, especially in Cumberland, Adams and Franklin counties. Much planting is now being done along the upper Susquehanna in Luzerne, Lackawanna, and Wyoming counties. In the southwestern part of the state, Bedford and Somerset counties also have many commercial orchards. Southern Pennsylvania has a longer growing season than New York and New England and this is plainly shown by the nature of the varieties most commonly grown. The older orchards are composed mainly of York Imperial, Baldwin and Northern Spy, but the newer plantings are mostly Stayman Winesap, McIntosh, Delicious, and Northern Spy.

Cultural peculiarities.

While there is diversity of opinion regarding cultural methods, the common practice embraces a system of clean culture with cover-crops. In some regions, especially on the heavier soils, it has been found that this treatment, if practised year after year, produces too much growth. In such cases, the cover-crop, instead of being turned under, is allowed to stand till about June, when it is cut and allowed to remain on the surface as a mulch. In New England, clover is most commonly used as a cover-crop. In New York and Pennsylvania, various crops are used for the purpose; among these the most common are clover, vetch, rye, buckwheat, turnips, cowpeas, and soybeans. Some growers in various parts have secured good results from growing their trees in sod, mowing the grass and leaving it as a mulch. The success of this method depends largely on the quantity of herbage that can be grown in the orchard. If the orchard does not produce enough, it must be supplemented with some form of coarse material from other sources. A system of this kind may be very satisfactorily employed in various parts of Pennsylvania, New York and New England, where there is much land that, although well adapted to apple-growing, is oftentimes too steep for cultivation.

268. Apple orchard at bearing age, as seen in the northeastern states.

As a rule, chemical fertilizers are used in the orchard. Since the supply of humus may be maintained in the orchard by the use of cover-crops, most growers prefer to use the available stable manure for crops like corn, hay, or vegetables, that are not so easily adapted to cover-crop treatment. Stable manure, however, is

often used in sod orchards to supply additional mulch as well as the elements of plant-food. Many growers are coming to realize that the apple tree does not require heavy applications of fertilizers. More important than fertilizers is moisture supply, and this is maintained by increasing the humus and by cultivation. Very few growers are applying much nitrogen, depending upon leguminous cover-crops to keep up the supply. As a source of phosphoric acid, raw ground bone is the most common material. In recent years, very large quantities of basic slag have been used, 600 to 800 pounds per acre usually being applied. Potash is usually applied in the muriate form, but some growers prefer to use the sulfate of potash. Recently, growers have realized the necessity for applying lime, and this is being used largely in the form of ground limestone.

There is a growing feeling that in the past young trees have been pruned too severely. Progressive growers think that the young apple tree should not be pruned very severely during the dormant season. With this is associated the idea that when much pruning is necessary, some of it, at least, should be performed in the growing season. This practice tends to bring the trees into bearing earlier and to make better-shaped trees. Summer pruning, when employed, is usually performed about July 1 or just before growth ceases. Mature trees tend to overbear, and pruning them in the dormant season is the rule.

269. Harvest time in the apple orchard.

A striking feature in the work of renovating old orchards is the severity with which many of the trees are pruned. High-headed trees, especially those that are very weak, are cut back to mere stubs on which the growth of water-sprouts is encouraged. From these sprouts new heads are formed. Trees treated in this way often produce fair crops of fruit, when properly trained, the fourth or fifth year following the treatment. Other trees that are in better shape to start with, are dealt with less severely, only the higher branches being removed and the remaining ones shortened in.

Spraying practices are about the same throughout the various regions of the Northeast. The concentrated lime-sulfur wash, either prepared or home-made, has become the standard remedy for scale. In some sections and especially for use on old apple trees, the miscible oils are preferred. For the various fungous troubles, of which scab, black-rot, rust and sooty-blotch are the most conspicuous, a weak lime-sulfur preparation is generally employed. Applications are usually made just before the blossoms open, again after the petals fall, and one or two later applications at intervals of three or four weeks. Arsenate of lead is usually added for the control of insects. In New England, the lime-sulfur as a summer spray has not given satisfaction, and the tendency is to use regular bordeaux mixture for the first application and a very weak bordeaux for the subsequent treatments. With most varieties, and under ordinary conditions, the one application is sufficient to control the various diseases. One or two applications of arsenate of lead, either with or without bordeaux, is usually applied after the blossoms have fallen.

The practice of thinning apples is becoming somewhat general among the commercial growers of New England and in most sections of New York and Pennsylvania. The work is usually performed about July 1, or just after the so-called "June drop." In some sections in western New York, where the evaporating trade takes the greater part of the crop, the practice is almost unknown.

Marketing.

The apple crop in general farming districts is mostly disposed of within the limits of the territory and usually in the local market. The more extensive growers, however, ship large quantities to the eastern cities, and varying quantities, depending upon the supply, are exported. Progress in grading and packing has been slow, chiefly because of lack of necessity. There is great demand in the manufacturing centers for a medium grade of fruit and in such places it has not paid to increase the price of apples by fancy grading and packing. Some growers, even at the present time, say that they make as much from their lower grades as from their higher grades. This applies especially to sections where peddlers come to the orchard, take the fruit away and bring the barrels back. The enormous number of varieties has also affected progress in the way of improved methods. Methods of packing and selling are very diverse. The barrel still remains the most popular package, although the box is being largely used. In the vicinity of the large cities and towns, special packages are used for the retail trade. Around Boston, a slatted bushel box is in common use. In Connecticut, the common Jersey peach basket is largely used, with a growing tendency toward the climax basket. Near Philadelphia, the familiar hamper is still in use. The box package as used in the West has been adopted by many growers in New York and in northern New England. In Connecticut, there is a movement to adopt a distinctive package, like the climax basket, for the fancy retail trade and to continue to use the barrel for the general crop.

C. D. Jarvis.

The apple in Canada.

Apples have been cultivated in Canada for about 300 years. In the early part of the seventeenth century, the French settlers brought with them seeds and trees to the banks of the St. Lawrence River, along which the first settlements were made. In that part of Canada which in the French régime was known as Acadia, now the province of Nova Scotia, apple trees were planted early in the seventeenth century also. Trees were top-grafted in Nova Scotia as early as 1764, and some of these old trees are still alive. On account of poor transportation facilities in Canada until comparatively recent years, the development of apple-growing was slow for a long time and it has been only during the past fifty or sixty years that a rapid growth in the industry has taken place. Now, however, the production of apples is large and is increasing very fast. In 1911 the number of bushels of apples grown in Canada was estimated at 10,384,985.

Regions.

The area in Canada over which apples can be grown is very large. In the provinces of Ontario and Quebec, there is a belt of about 700 miles in length, where apple trees can be successfully grown, while in the province of Ontario alone the best winter apples can be

grown over an area of about 350 miles long by 30 to 150 miles in width. Over this great winter-apple area, which may be roughly divided into, first: that part bordering on Lake Ontario and extending for 30 and more miles inland; second, that bordering Lake Huron and for several miles back; and third, the southwestern part of Ontario,—the Northern Spy, Baldwin, Tompkins King and Rhode Island Greening are the predominant winter varieties of the better class.

Nova Scotia has long been noted for its winter apples, which ship and keep well. The most favored parts are the Annapolis and Cornwallis valleys, which have a total length of about 100 miles and vary in width from 6 to 11 miles. Here apples of British or European origin, such as Blenheim, Ribston, Gravenstein, Cox Orange Pippin, and Yellow Bellflower do particularly well. But it is being found that winter apples can be grown successfully along the southeastern part of Nova Scotia, and a large area will no doubt be eventually planted to apple trees there. In the northern part of Nova Scotia, the hardier apples, including some winter varieties, do well. Prince Edward Island, the smallest province in Canada, produces excellent apples, and here may be found, perhaps, the longest-keeping fruit in Canada of the varieties grown, due no doubt to the cool autumn. The season is somewhat short for some of the latest-maturing varieties. The province of New Brunswick has for a long time shown its adaptability for apple-culture, and in this province some of the highest-colored and best-flavored apples are grown. The climate over a large part of New Brunswick is much the same as the southern part of the province of Quebec and eastern and central Ontario, and over this great area such apples as Wealthy, Fameuse, McIntosh, Alexander, Wolf River and others are grown to great perfection.

In the far West, British Columbia has many districts and valleys well suited for summer, autumn and winter varieties of apples, but some varieties do better in one district than in another. At present the three most important parts are, first, that comprising the damp climate of the lower mainland near the coast, and Vancouver Island; second, the dry interior country where irrigation is, as a rule, necessary, including the Okanagan and other valleys; and third, the Kootenays, East and West, the Salmon Arm, and other districts where irrigation is in most places unnecessary. Many valleys farther north than the present commercial orchards extend are being found suitable for apple-culture.

In the prairie provinces of Manitoba, Saskatchewan and Alberta, few apples have as yet been grown, but it is thought that before long some parts of these provinces will be producing large quantities of apples. In southern Manitoba the Russian varieties of apples are succeeding well in places where cared for, and considerable quantities of fruit have been obtained there. The chief causes of failure in the prairie provinces appear to be, first, too late growth, preventing proper ripening of the wood, and due, we believe, to the rich soil with its large percentage of available nitrogen; second, to the drying out of the trees in winter on account of their being exposed to dry and very cold winds for a long period; and third, on account of early growth in spring followed by hard frosts. All of these causes of failure may in a large degree be overcome by planting the hardiest varieties in well-drained, light soil, protecting them from winds in winter by means of windbreaks, and choosing exposures where growth will not start early. In the wooded country in northern Saskatchewan and Alberta, where the springs are cooler and where there is natural protection, it is thought that ultimately large quantities of apples will be grown. At present crab-apples are being grown in a number of places and also the small hybrid apples originated by William Saunders.

The farthest north that apples have been grown in Canada east of the Rocky Mountains, of which we have a record, is at Fort Vermilion, Peace River, in latitude 56°, where, in 1910, fruit was grown of the hybrid apples referred to.

Varieties of apples recommended for different parts of Canada.

Ontario (districts bordering Lake Ontario and Lake Huron, and southwestern Ontario): *Summer*—Red Astrachan, Oldenburg. *Fall*—Gravenstein, Wealthy, Alexander, McIntosh, Fameuse, Blenheim. *Winter*—Tompkins King, Rhode Island Greening, Baldwin, Northern Spy, Cranberry, Stark.

Nova Scotia (Annapolis, Cornwallis, and adjacent valleys): *Summer*—Red Astrachan, Oldenburg. *Fall*—Gravenstein, Wealthy, Blenheim, Ribston. *Winter*—Tompkins King, Yellow Bellflower, Wagener, Cox Orange Pippin, Rhode Island Greening, Stark, Northern Spy, American Golden Russet, Fallawater, Roxbury Russet (Nonpareil), and Ben Davis.

Nova Scotia (northern and colder parts) New Brunswick, Quebec (except coldest parts), Eastern and Central Ontario: *Summer*—Transparent, Lowland Raspberry, Oldenburg. *Fall*—St. Lawrence, Wealthy, Dudley, Alexander, McMahon. *Winter*—McIntosh, Fameuse, Wolf River, Bethel, Milwaukee.

Prince Edward Island: *Summer*—Transparent, Oldenburg. *Fall*—Wealthy, Dudley, Gravenstein (whick keeps well into winter here). *Winter*—Alexander, Wolf River, McIntosh, Stark. Such varieties as Blenheim, Ribston, Tompkins King, Northern Spy, and many others can be grown on Prince Edward Island, but are not so reliable for commercial purposes.

British Columbia (lower mainland, Vancouver Island): Yellow Transparent, Oldenburg, Gravenstein, Wealthy, Tompkins King, Grimes. For irrigated districts of Southern British Columbia: Transparent, Red Astrachan, Oldenburg, Wealthy, McIntosh, Jonathan, Wagener, Rome Beauty, and in addition for the most favored parts, Esopus, Yellow Newtown, and Winesap. Other temperate parts where irrigation, if practised, is not general, including the Kootenays, Salmon Arm, and Armstrong district: Yellow Transparent, Oldenburg, Gravenstein, Wealthy, McIntosh, Jonathan, Wagener, Grimes and Northern Spy.

Hardiest varieties for coldest parts of Canada: *Summer to Autumn*—Blushed Calville, Lowland Raspberry, Oldenberg, Charlamoff. *Autumn to Winter*—Antonovka, Wealthy, Hibernal, McMahon, Longfield, and Patten. *Crab-apples*—Whitney, Virginia Martha, Transcendent, Hyslop and the small hybrid apples originated by Wm. Saunders.

Up to comparatively recent years, Canada had depended mainly on the other parts of the world for varieties to plant, but some excellent apples of Canadian origin are now in commerce, such as Fameuse, McIntosh, St. Lawrence, and Baxter. Within the past twenty years under the direction of the Dominion Government, many new varieties have been originated with a view to furnishing suitable kinds for the prairie provinces, and secondly to obtain apples of the best color and quality which would succeed over a wider range than those on the market at present. The results so far have been very promising.

General outlook.

Canadians are fully alive to the importance of practising the best methods of apple-culture, and in those parts of the Dominion where the industry is an important one, the methods employed and culture given are equal to those in other countries.

The coöperative movement is strong in Canada, and there are many coöperative associations for the buying of horticultural supplies and for the marketing of fruit. There has been an Act in force in Canada since 1899 by which Dominion inspectors may examine fruit packed in closed packages before shipment in any part of Canada. The Act empowers the inspectors to mark the package "Falsely Marked" if the fruit within the package is not of the grade or quality indicated by the marks outside, and the person who packs the fruit and marks the package is liable to a fine.

There is a minimum standard or legal barrel of 96 Imperial quarts for apples throughout Canada, and a uniform box of 10 x 11 x 20 inches, inside measurements. The barrel is still the popular package in eastern Canada, although the use of the box is steadily increasing. In British Columbia, however, the box is used practically altogether.

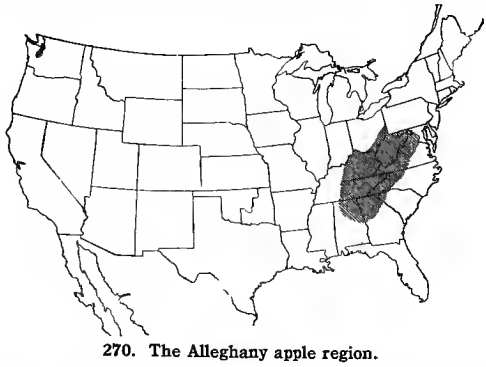
The outlook for apple-growing in Canada is bright. The market for Canadian apples appears to be

unlimited, if the fruit is well packed and properly distributed, and the quantity of apples that Canada is able to produce is enormous. For further information, see *British North America, Horticulture in.*

W. T. Macoun.

The apple in the southern Alleghany Mountain region. Fig. 270.

With respect to climatic conditions, the Alleghany region presents the widest range of extremes within short distances in eastern North America. Extending through nearly seven degrees of north latitude, its great



270. The Alleghany apple region.

valleys, plateaus, detached hills and long ridges vary in elevation from 500 to more than 4,000 feet above sea-level, presenting in their varied slopes almost every angle of exposure to the sun. Correspondingly varied soils occur also, often in close proximity, so that within short distances, combinations of soil and climatic conditions adapted to more widely differing types of plants are found than elsewhere in the humid regions of the United States. The extreme contrasts occur in western North Carolina, where in the sheltered valleys and thermal belts of the eastern slopes of the Blue Ridge, the fig and the European grape are grown with a fair degree of success within a few miles of higher lands well adapted to a wide range of winter apples.

While fewer chronological records have been preserved of the earlier history of apple-culture in this region than is true of some of the more northern apple districts, it is evident from scattered references that in some localities in Virginia and North Carolina, rather systematic culture of this fruit was undertaken in a small way at a very early date.

It is known that as early as 1686 there was one apple orchard of 2,500 trees in Virginia, mostly grafted, and that by the close of the seventeenth century, few plantations in that state were without orchards. In these, the apple was the leading fruit along with the peach, the pear, the plum, the quince and some others. As early as 1773 Thomas Jefferson recorded in his "Garden Book" the grafting of "Newtown Pippin" in Albemarle County, Virginia, and in 1778 the planting of these grafted trees on his Monticello estate. This variety had apparently reached that section from the vicinity of Philadelphia as early as 1755 in the form of cions brought in the saddle-bags of Dr. Thomas Walker, the commissary officer of the Virginia troops in Braddock's army, when he returned after the disastrous defeat of that year. (See Bulletin 5, Division of Pomology, U. S. Department of Agriculture, p. 360.–1898.)

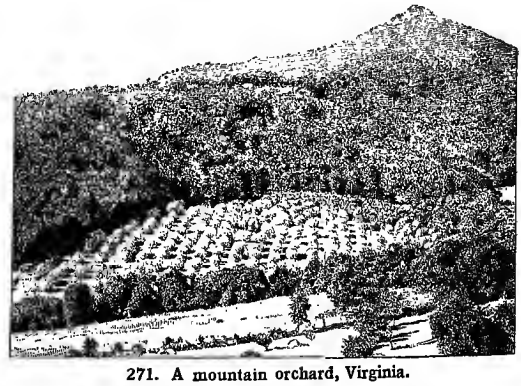
But if written records were entirely lacking, the large size and evident age of the surviving trees about farm dwellings and the abundant distribution of seedling apple trees of great age and large size at the present time would sufficiently establish the fact of early introduction and the general adaptability of the conditions to the requirements of the apple. The late T. K. Bruner, of North Carolina, cites an example of an

orchard in Haywood County in that state in which, though never cultivated, a hundred trees had attained a size of full 3 feet in diameter of trunk, the largest having a girth of 11 feet and 9 inches. While these exceptionally large trees are usually found in the lower slopes or in mountain coves where the wash from the mountainsides above brings to them the moisture and fertility of considerable areas of land, many unoccupied benches and gradual slopes exist where such soil conditions could be approximately duplicated by the orchardist.

Varieties of the Alleghany region.

While less attention has probably been given in this region to the systematic study of the seedling fruits that have originated there than in most of the earlier settled parts of the country, upwards of fifty varieties of the 319 included in the last catalogue of fruits of the American Pomological Society are traceable to this region. These include such commercially important varieties as Ben Davis, Grimes' Golden, Kinnard, Paragon and Willow, together with such highly esteemed home-use sorts as Bonum, Buckingham, Gilpin, Pilot, Red June, Shockley, Summer King, Terry and Virginia Beauty. R. L. Watts, working in Tennessee, and C. C. Newman, in South Carolina and Georgia, have made a beginning in the canvass of the region for valuable seedlings in connection with their experiment-station work, but this region undoubtedly remains at the present time the most promising field in America for the searcher after promising new varieties of apples.

As in most of the earlier settled parts of the country, commercial development of orchards in this region is comparatively recent. The first plantings were solely for home-supply. Later, small orchards were planted for the production of sun-dried apples, cider, apple-brandy and similar products in a commercial way, rather than for the sale of the fresh fruit on any extensive scale. So long as these uses determined the selection of trees for planting, little attention was paid to varieties, or, in fact, to the perpetuation of varieties at all; hence the numerous small seedling orchards persisting throughout the less accessible portions of the region at the present time. Gradually, in certain localities, the quality of fruit produced gave the more durable winter varieties a money value for marketing by wagon, river-boat or railroad to more distant markets. The longer-keeping Winesap and other winter apples of Tennessee found profitable wagon-market demand in the lower valleys of Alabama and Georgia where this



271. A mountain orchard, Virginia.

fruit did not succeed. The Willow, Gilpin and Bentley of the northern Panhandle of West Virginia found eager buyers when transported by boat down the Ohio and Mississippi Rivers as far as New Orleans. The Yellow Newtown, rechristened Albemarle Pippin in the county of that name (under the impression that it was a dis-

tinct sort) found its way from Virginia by railroad to the eastern seaboard cities and at an early date moved across the Atlantic in considerable quantities, where its durability and fine dessert quality created an active demand at prices that yielded a good profit to the grower.

Extent of the planting.

Gradually commercial orcharding has been differentiated from ordinary farm fruit-growing and a considerable number of farms have become distinctively orchard farms on which the apple is the main crop, with merely such cereals and forage crops as can be grown without interfering with the essential orchard operations, such as orchard cultivation, spraying, harvesting, and the like.

Most of the systematically planted and cared for orchards are under thirty years of age and a large proportion of the acreage in these has been planted since 1900. Accurate statistical information regarding the acreage or number of trees of orchard fruits in the United States is lacking, and this is peculiarly true of those regions in which, because of varying topography and the resulting eccentricities of climate and variations in soil, the orchard areas vary greatly in size and form, as is true of much of this region. Outside of the Great Valley of Virginia, and Tennessee, and those portions of the Piedmont region of Virginia that are adapted to orcharding, most of the best orchard sites occur as coves, benches or broken slopes, possessing at the same time suitable depth and character of soil, and adequate atmospheric drainage. (Figs. 271, 272.) Some of the best orchards are strung out along the lower slopes, varying in width in accordance with particular soil types. This is especially true of the "pippin orchards" in the Blue Ridge district of Virginia and North Carolina where certain particular combinations of soil and slope are considered important for the Yellow Newtown.

The following summary of the number of trees, both bearing and non-bearing, and of yield and value of crop in the eight states comprised in the region, is compiled from the advance sheets of the census of 1910:

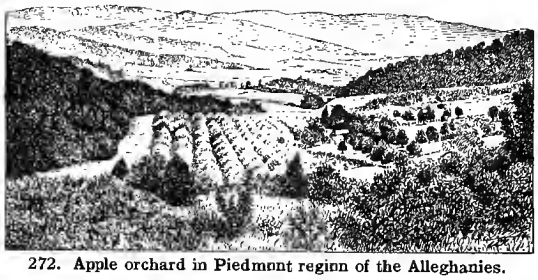
APPLE IN SOUTHEASTERN UNITED STATES, CENSUS OF 1910.

	Trees, April 15, 1910		Product, 1909.	
	Of bearing age	Not of bearing age	Bushels	Value
United States..	151,323,000	65,792,000	147,522,000	$83,231,000
Virginia.....	7,005,000	3,436,000	6,104,000	3,130,000
W. Virginia....	4,571,000	2,772,000	4,225,000	2,461,000
N. Carolina....	4,910,000	1,835,000	4,776,000	2,015,000
S. Carolina.....	582,000	269,000	363,000	276,000
Georgia.....	1,878,000	822,000	896,000	556,000
Alabama.....	1,468,000	738,000	888,000	621,000
Tennessee.....	4,839,000	2,117,000	4,640,000	2,172,000
Kentucky.....	5,538,000	2,106,000	7,368,000	3,067,000
	30,791,000	14,095,000	29,260,000	$14,298,000
	20 per cent	20 per cent	19 per cent	17 per cent

It will be observed on comparison of these tables with those of the United States as a whole that this region is credited with approximately 20 per cent of both bearing and non-bearing trees, and that the product of the region in the crop year of 1909 was of somewhat smaller proportion (19 per cent) and value (17 per cent).

Outlook for the Alleghany region.

In contrast with the more northern apple districts, most of this region was until recently somewhat at a disadvantage so far as commercial production is concerned. Higher humidity favored the development of certain injurious diseases in foliage and fruit; the warmer weather commonly prevalent in autumn accelerated ripening and therefore shortened the storage durability of the fruit; relatively long hauls from orchards to railroad station over rough roads resulted in much bruising and, by prolonging the exposure of the fruit to the weather, still further impaired its keeping quality. The development of efficient remedies and spraying equipment, and the improvement in methods of handling the fruit, coupled with the marked improvement in roads that has been accomplished in many sections is rapidly changing this. The railroads also, in recognition of the need have accelerated and improved their service so that certain parts of the region are handling their apples as well as the best eastern or barrel-fruit districts, and better than in much of the older commercial apple territory.



272. Apple orchard in Piedmont region of the Alleghanies.

The conspicuous essentials of success in orcharding in this region, as in others, are:

(1) *Suitability of site*, as regards character of soil and adequacy of atmospheric drainage.

(2) *Adaptability of varieties to the soil and climate of the location.*—The standard northern varieties, though growing and frequently bearing well, are unreliable in most localities, especially below elevations under 200 feet, although in certain localities succeeding well under careful management. The thoroughly proved and distinctively important commercial sorts of the region are York Imperial, Winesap, Stayman Winesap, Kinnard, Ben Davis, Yellow Newtown, Grimes, Willow and Rome Beauty. In some sections less well-known sorts, such as Paragon, Arkansas (syn. Mammoth Black Twig), Bonum, Virginia Beauty, Lowry, Shockley, and Terry, are considerably planted in commercial orchards.

Gano, Delicious, Jonathan and some other sorts of Mississippi Valley or northern origin are promising in certain localities, but these have not yet been sufficiently tested to justify extensive planting.

Summer varieties, though succeeding well throughout most of the region and universally found in sufficient quantity for home use, have not become so important commercially as in the lower lands of the tidewater districts and of the Mississippi Valley. This is in a large measure due to the earlier ripening of the fruit at lower elevations, which frequently gives it a distinct advantage in northern markets. Recently, considerable plantings of Yellow Transparent, Williams, Oldenburg, Gravenstein and some other sorts have been made in the more northern districts of the region, especially in West Virginia and western Maryland.

(3) *Abundance of water for spraying.*—The necessity of thorough and systematic spraying of orchards to protect against insects and fungi makes the orchard water supply an important factor. In many places, flowing springs are available at considerable elevations from which the supply can be piped by gravity to convenient mixing stations, thus permitting prompt distribution without long wagon haul of liquid. The use of compressed-air spraying-outfits, charged at conveniently located air-compressing and spray-mixing stations, has developed more largely in the lower Shenandoah Valley part of this region than elsewhere, but the gasoline engine is the prevailing type of equipment.

(4) *Adaptability of land to cultivation.*—While occasional orchards in this as in other humid regions do well without systematic tillage, especially if heavily mulched with stable manure, straw or other humus-producing material, annual or at least alternate-year plowing and cultivation, supplemented by leguminous crops, is rapidly becoming the generally accepted best practice of the region. Some sites otherwise admirably adapted to apple-growing are too rocky or too steep to plow, and therefore of doubtful value to the orchardist. Much can be done on such sites by contour-terracing, however, both to dispose of loose rocks and to reduce washing of the slopes, thereby conserving the soil moisture against drought periods.

(5) *Adequacy of transportation facilities.*—This includes both railroads and highways. Some of the earlier-planted commercial orchards were located as much as 15 to 25 or even 30 miles from the shipping station. The expense incident to this long haul and the ill effect of the jolting and exposure of the fruit to the weather are evident. Every additional mile beyond a distance of 3 miles from the station over a good road is a handicap which the orchard

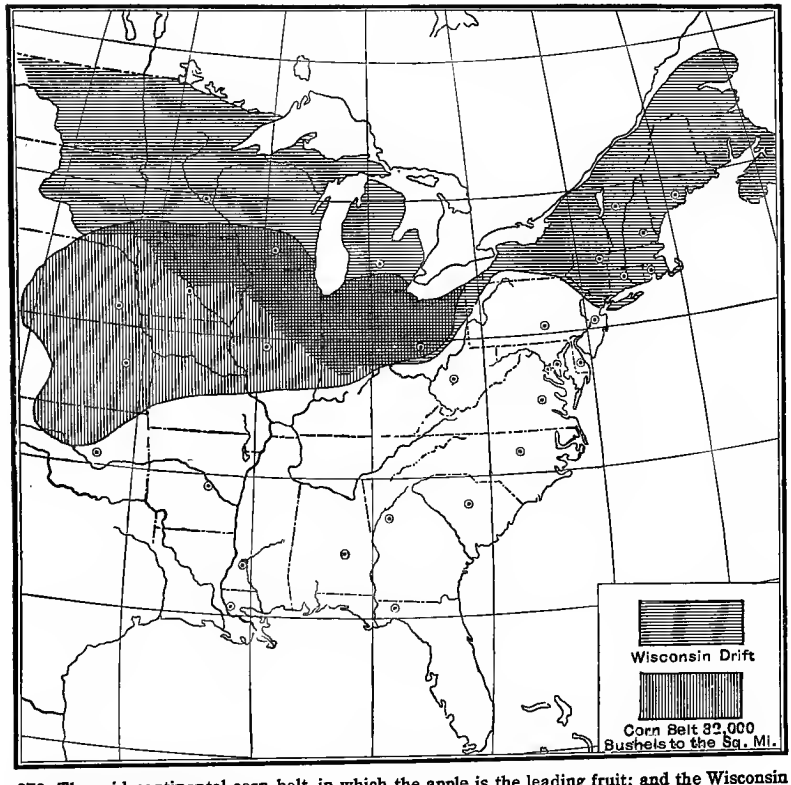
planter should avoid unless it is overbalanced by other important advantages. As roads are improved, the practical distance will increase.

Several of the State Experiment Stations, as well as the United States Department of Agriculture and the North Carolina Department of Agriculture, have published bulletins bearing on different phases of apple-orcharding, especially Maryland, Virginia, West Virginia, Tennessee, and South Carolina.

WM. A. TAYLOR.

The apple in mid-continental or plains districts.

In that vast region of the interior of the United States which lies between the Great Lakes, Ohio, Kentucky, and Tennessee on the east and the Rocky Mountain states on the west, the Canadian boundary on the north and the Gulf states on the south, the leading fruit is the apple. This mid-continental territory includes the greater part of that exceptionally rich agricultural region which has come to be known as the corn-belt of America. (Fig. 273.) It extends also into the northern wheat-belt of the Upper Mississippi Valley plains and into the wheat and livestock country of the Great Plains Plateau of Oklahoma, Kansas, Nebraska, and the Dakotas.



273. The mid-continental corn-belt, in which the apple is the leading fruit; and the Wisconsin drift, on which the Ben Davis family is not at its best.

Geography.

The topography may be indicated in a very general way by the statement that this region takes in the Upper Mississippi Valley plains, a large part of the Great Plains Plateau, and all of that more limited area known as the Ozark Plateau. Its great river valleys are those of the Ohio, Mississippi, Missouri, Arkansas, and Red. A limited area in Minnesota and the Dakotas lies in the valley of the Red River of the North and a rather narrow strip along the northeast boundary lies in the basin of the Great Lakes.

The larger part of this mid-continental district, as outlined, has an elevation of 500 feet to 2,000 feet above sea-level. The southwest point of Indiana, southern Illinois, southeastern Missouri, and eastern Arkansas have an elevation of less than 500 feet. The remainder of Indiana and Illinois, much of Missouri, and a portion of southern and eastern Iowa lie between 500 feet and 1,000 feet elevation. The range of elevation of 1,000 to 2,000 feet takes in the remaining parts of Iowa, most of Minnesota, and the eastern part of the Dakotas, Nebraska, Kansas, Oklahoma, and the Ozarks. The remainder lies to the west in the Great Plains Plateau at an elevation above 2,000 feet.

In the more northern and western districts of this region, there is little or no commercial orcharding. Only in their more favored localities are apples produced at all, and the lists are restricted to the hardier varieties. This is because the recurring extremes of temperature and of drought make the environment unfavorable to the apple, at least during critical periods. But throughout the states of the corn-belt, the apple is very generally grown for home use and certain sections show a notable development of commercial orcharding (Figs. 274, 275). In fact, the most extensive individual apple orchards known are found in parts of Arkansas, Missouri, Kansas, and Illinois, some of them being several hundred acres in extent.

Orchards well located and rightly managed are proving to be profitable in different sections of the corn-belt states. With the rapid growth of the United States in population and wealth, must come a corresponding increase in the home-market demand for good apples at remunerative prices. This, with the improvement and extension of storage and transportation facilities and the contemporaneous expansion of our foreign trade, tends to make the outlook encouraging for the apple-growing industry in this region. The more general adoption of up-to-date methods of marketing and of orchard management will help to put the industry on a more stable basis, and gradually to enlarge it and extend it.

Rank in apple-production.

According to the United States census reports of 1910, approximately 40 per cent of the bearing apple trees of the United States is found in the territory above outlined, together with 33 per cent of the young trees not yet of bearing age. In the census year of 1909, it produced approximately one-fourth of the apple crop of the entire United States.

Following is a list based on United States census reports, which indicates something of the relative standing. For comparison they are also ranked as to their averages in apple-crop production for 1905, 1907, and 1909, combined on the basis of the crop reports published in the American Agriculturist Yearbook:

RANK OF MID-CONTINENTAL STATES IN YIELD OF APPLES. Fig. 274.

Name of State	1909		1899		1905-7-9
	Rank in United States	Yield in bushels	Rank in United States	Yield in bushels	Rank based on combined averages
Missouri.....	4	9,969,000	9	6,496,000	16
Iowa.....	6	6,747,000	18	3,129,000	19
Nebraska..	15	3,321,000	23	1,343,000	26
Illinois.....	16	3,093,000	5	9,178,000	11
Indiana....	17	2,759,000	7	8,620,000	13
Arkansas...	20	2,296,000	20	2,811,000	21
Wisconsin..	21	2,232,000	33	303,000	27
Kansas....	27	1,356,000	16	3,214,000	25
Minnesota..	29	1,044,000	40	120,000	
Oklahoma..	32	742,000	41	111,000	
S. Dakota..	40	192,000		*	
N. Dakota.	47	4,000		*	

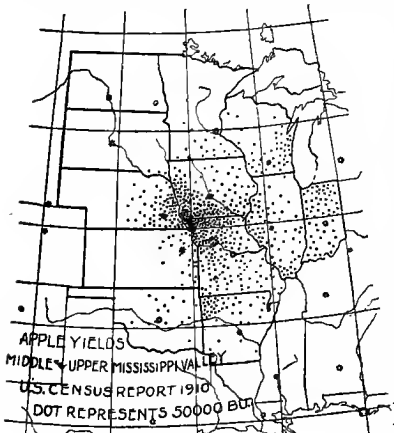
*Record included with other states.

RANK OF MID-CONTINENTAL STATES IN NUMBER OF ORCHARD TREES IN CENSUS YEAR 1909. Fig. 275.

	Bearing Trees		Non-bearing Trees	
	Rank in United States	Number	Rank in United States	Number
Missouri.....	1	14,360,000	3	3,625,000
Illinois.....	3	9,901,000	7	2,548,000
Arkansas.....	6	7,650,000	2	3,940,000
Kansas.....	9	6,930,000	24	1,116,000
Iowa.....	10	5,847,000	17	1,914,000
Indiana.....	11	5,765,000	16	1,962,000
Oklahoma.....	18	2,956,000	14	2,060,000
Nebraska.....	19	2,937,000	27	967,000
Wisconsin.....	21	2,430,000	21	1,409,000
Minnesota.....	26	1,380,000	19	1,572,000
South Dakota....	41	275,000	34	461,000
North Dakota....	47	16,000	44	70,000

Apple belts.

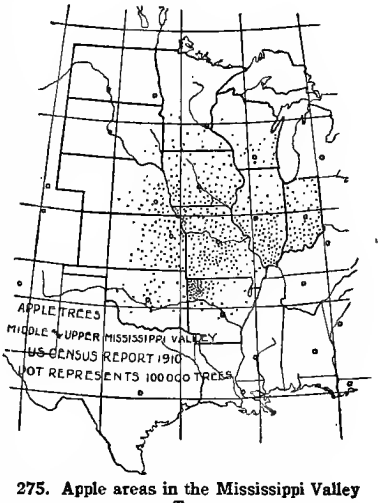
In comparing the great apple-growing regions of the continent it is convenient to designate each by its leading variety. In the eastern part of the continent, there is the Fameuse or Wealthy belt on the north, the Ben Davis belt on the south, and the Baldwin belt lying intermediate between these two. It is seen that varieties differ greatly as to their adaptability to different regions. The degree of soil aëration and of soil moisture and the range of atmospheric and soil temperatures are among the most important determining factors of the geographical range of commercial apple-growing with any variety.



274. Apple areas in the Mississippi Valley—Yields, 1909 crop.

Passing westward into the mid-continental region, it is found that the Baldwin belt does not extend west of Lake Michigan. The climatic extremes are here too severe for that variety and many of its eastern associates of a similar degree of hardiness. In all that vast territory which extends westward from the Great Lakes, these varieties disappear and do not again appear till the states of the Pacific Coast are reached. Instead, the Wealthy belt extends southward till it reaches the region where Wealthy yields leadership to Ben Davis.

In this connection it is worthy of note that from the Atlantic Coast westward to the Missouri River the north margin of the Ben Davis belt approximately coincides with the southern boundary of the geological area covered by the Wisconsin drift. (Fig. 273.)



275. Apple areas in the Mississippi Valley —Trees.

Wealthy belt.—The mid-continental territory in which Wealthy is, generally speaking, the leading variety, includes northern Illinois, the north half of Iowa, and practically all of the apple-growing districts of Wisconsin, Minnesota, South Dakota, and northern Nebraska. Among the more important varieties associated with it are, for the more northern parts, Oldenburg, Okabena, Patten (Patten Greening), and Malinda. Among the very hardiest of the large-size apples for the North are those of the Hibernal group, but their fruit is so austere that it is esteemed of little value except for culinary uses. In the southern part of the Wealthy belt are grown hardy varieties of more or less local value such as Salome, Windsor, Black Annette, and Colorado Orange, varieties which as yet have not established themselves in the great world markets but which are valued where better varieties cannot be satisfactorily grown.

Ben Davis belt.—Generally speaking, Ben Davis is the leading variety in central and southern Illinois, the south half of Iowa, and the apple-growing districts of Arkansas, Oklahoma, Missouri, Kansas, and the south half of Nebraska. With its close kin, the Gano and the Black Ben Davis, which evidently are highly-colored bud-sports of Ben Davis, it probably produces at least one-half of the commercial apple-crop in this region. Winesap and Jonathan appear to be next in order of importance, with Winesap perhaps in the lead. Other important varieties are Grimes, Rome Beauty, Willow (Twig), Missouri (Pippin), Minkler, and Ralls. York Imperial is gaining ground. Stayman Winesap is one of the newer kinds which will be more largely planted. Delicious, also, is attracting attention, particularly because of its agreeable dessert quality and good appearance. The Stayman and Delicious are being planted to some extent in the southern part of the Wealthy belt, as Jonathan and Grimes have been.

Varieties.

The following varieties of apples are those most commonly grown in the prairies and plains regions:

Arkansas (Mammoth Black Twig).
Ben Davis.
Black Ben Davis.
Gano.
Grimes Golden.
Ingram.
Jonathan.
Minkler.
Missouri.
Oldenburg.
Ralls (Ralls Genet, Geniton).
Rome Beauty.
Salome.
Stayman.
Wealthy.
Willow (Wiliow Twig).
Winesap.
Yellow Transparent.
York (York Imperial).

Status of the apple industry in the mid-continental states.

Wisconsin.—Apples are grown mostly in small plantings about homesteads. The crop is important chiefly in supplying the home and the local markets with summer and fall fruit. The varieties are those of the Wealthy belt.

Minnesota.—Apple-growing is chiefly confined to the southeastern quarter of the state, although crab-apples and the very hardiest apples are being planted in other sections. From Minneapolis southward to the Iowa line, many farm orchards are found and some commercial plantings. Heretofore, these have seldom produced enough fruit to supply the local demand at any time and then for a brief period only. However, apple-production is gradually increasing in the state and apple-planting is being slowly extended. It will doubtless assume greater proportions as late-keeping varieties are developed which are hardy and desirable.

North Dakota.—This state raises but very few apples or crab-apples and those only of the kinds most resistant to cold and drought. It ranks next to the bottom of the list in apple-production among the states of the Union.

South Dakota.—Apples are produced in very limited quantities and chiefly near the Missouri River in the southeast corner of the state and in the Black Hills district. The varieties are those of the northern section of the Wealthy belt. The recommended list of the State Horticultural Society includes: Northern District—first degree of hardiness—Hibernal, Oldenburg (Duchess); second degree of hardiness—Patten (Greening), Anisim, Wealthy. Southern District—in addition to the above—Northwestern Greening, Malinda, and, in favorable locations, Ben Davis. Planting increases slowly.

Nebraska.—Apples are grown in the eastern third of the state and under irrigation in some places farther west. It has some important commercial orchards, the majority of them being in the southeastern part of the state and within three counties of the Missouri River. The northern third of the state grows the varieties common to the Wealthy belt. In the southern two-thirds are grown the Ben Davis and its kin and also Winesap, Grimes, Arkansas or Mammoth Black Twig, Jonathan, Missouri (Pippin), Willow (Twig) and others of the Ben Davis associates. Planting is not active, but growers are beginning to take a more lively interest in modern methods of orchard management.

Iowa.—In the amount of crop produced, Iowa was ranked sixth in the Union by the 1910 census, but often it drops as low as the eighteenth or nineteenth place. The greater proportion of the crop is grown in home orchards and goes to supply home and local market demands, but in the aggregate there is a considerable number of commercial orchards. These are found in all parts of the state. They are sparsely scattered in the north and gradually increase in number to the southward, being most abundant in the south tier of counties. The most important commercial apple district includes the counties bordering the Missouri River in southwestern Iowa. Here Grimes and Jonathan of superior quality are grown. Northern Iowa grows the varieties of the Wealthy belt. The southern Iowa list is almost identical with that given for southeastern Nebraska. Planting is not active. Modern methods of management are being adopted by a few of the more progressive growers but most orchards suffer from neglect.

Illinois.—At present, Illinois takes second rank in apple-production among the mid-continental states, being surpassed by Missouri only. Northern Illinois, like Wisconsin, grows apples chiefly for home use and the varieties are those of the southern area of the Wealthy belt. Central and southern Illinois contain altogether many large commercial apple orchards. In good-crop years, they produce in the aggregate large quantities of winter apples, including Ben Davis, Black Ben Davis, Gano, Arkansas or Mammoth Black Twig, Winesap, Jonathan, Grimes, Missouri, Willow, Ralls, and several other varieties commonly found in the Ben Davis belt. Winter injury and late spring freezes have often seriously diminished the general crop. Injurious insects together with blight, cankers, bitter-rot, blotch, scab and other diseases, have also caused great losses. Clean tillage and other up-to-date orchard methods would doubtless be more generally practised if crops were more reliable. Planting is not very active, although the number of trees of bearing age is gradually increasing.

Missouri.—The 1900 census gave Missouri ninth rank and the 1910 census gave it fourth rank in apple-production, but it often falls as low as the sixteenth place among the states of the Union. On the whole, it may be regarded as the leading apple state of the mid-continental region. Apples are very generally grown for home use and local market throughout Missouri, but the more important commercial apple districts are in the Ozark country of southwest Missouri and the loess soil region along the Missouri River in the northwest quarter of the state. The apple industry in Missouri has been retarded by troubles similar to those described for Illinois, but undoubted progress is being made in knowledge of the methods for holding them under control.

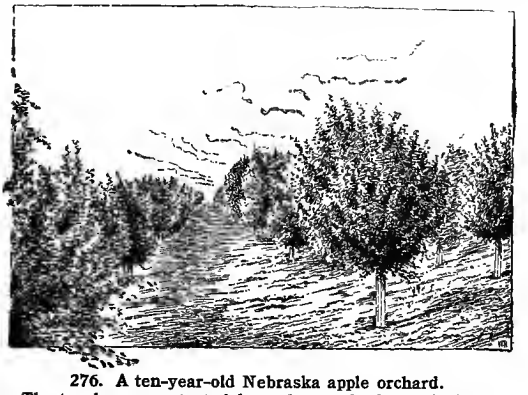
Arkansas.—The apple districts of Arkansas are mostly located in the northwest third of the state, particularly in the two northwest counties of Benton and Washington, which have from four to five million trees planted. There is also an undeveloped west-central region. The older plantings include about 90 per cent Ben Davis, Arkansas or Mammoth Black Twig, and Winesap. The later plantings are made up principally of Gano, Black Ben Davis, Jonathan, Grimes, Winesap, Stayman Winesap, with some Ingram, Collins, King David, and Delicious. Arkansas has enough apple trees of bearing age to produce a very large crop, but as in Missouri and Illinois, within recent years unfavorable climatic conditions with diseases and injurious insects have proved a rather serious handicap to the progress of the apple industry. Generally speaking, planting is not now being rapidly extended. The planting of thousands or even hundreds of acres under one management is fortunately no longer generally regarded with favor, and the trend is distinctly towards reducing the individual holdings to a size that is compatible with careful and thorough orchard management. The future will see a large development of commercial apple-growing in this region.

Kansas.—Northeastern Kansas from Topeka northward to the Nebraska line and northeastward to the Missouri River forms a part of an important apple-growing region which takes in southeastern Nebraska, southwestern Iowa, and northwestern Missouri. Here Jonathan and Grimes are grown to a high degree of perfection, together with Ben Davis, Gano, Winesap, and other varieties of the Ben Davis belt. There is another important apple district which is located in the Arkansas Valley from Hutchinson to the Oklahoma line. In recent years, this has taken the lead in crop-production in this state. The older Kansas orchards were largely of Ben Davis, Gano, and Missouri. The newer plantings have more of York Imperial, Jonathan and Grimes. Other varieties common to the Ben Davis belt are also found.

Oklahoma and northwest Texas.—In Oklahoma, the apple has not yet developed very large commercial importance. Planting is gradually increasing in the Red River section and also in west Texas where the altitude reaches 2,000 feet. Here Ben Davis, Missouri and Arkansas Black are among the most important commercial varieties.

Establishing and managing the orchard on the prairies and plains. Fig. 276.

Preparation of land.—The fundamental principles of proper preparation of soil for orchard planting in the mid-continental country are much the same as those that are set forth for other regions, although they may differ somewhat in relative importance. One of the first things to be considered is the matter of putting the soil in such condition that the entire root-system of the apple tree may withstand, without injury, any period when the soil is filled with water. Unfortunately, the importance of this is not generally nor fully realized, even among experienced orchardists. The principle that apple roots must have a constant supply of air in order to do their work should never be lost sight of. Stagnant water cuts off the supply of air to the roots and very quickly impairs the health of the root-system. Excepting on such soils as deep porous loess, or when the subsoil is of such a sandy or gravelly nature as to



276. A ten-year-old Nebraska apple orchard. The trunks are protected from the sun by board jackets.

let the surplus water pass off readily, it may be laid down as a general principle that thorough tiling is fundamental to the highest degree of regular and abundant crop-production and longevity of the apple tree. On land where the general slope is sufficient to carry off the surface water and even on hillsides, tiling may be, and often is, essential to the best success. The lines of tile should be not less than 4 rods apart and in many cases 2 rods apart gives enough better results to more than repay the extra expense. Even in arid regions, progressive orchardists are learning that, under irrigation, in many places it becomes necessary to under-drain the land so as to prevent the seepage and waste-water from water-logging the soil and damaging the root-system of the trees.

Humus.—It is highly important that the orchard soils have an abundance of humus to begin with, and that the supply be continually kept up by the use of either green manures or barnyard manure or both. The humus not only puts the soil in a more fertile condition but increases its moisture-holding capacity and gives it greater ability to withstand drought. The necessity of promptly getting rid of surplus water in the soil has already been emphasized. It is equally important to conserve soil moisture so as to carry the tree unharmed through any periods of drought that may occur either in summer or winter. Generally speaking, this can best be done in the mid-continental regions by thorough tillage during the growing season, followed by the growing of cover-crops. In places where soils wash so badly that this practice cannot be followed, perhaps the next best way to develop the capacity of the soil to hold moisture is by the use of barnyard manure and the growing of clovers or other crops that can be mowed twice or more during the season and allowed to rot on the ground.

It is well to grow grain or some cultivated crop on the land the season previous to planting the orchard. The land may then be fall-plowed to a good depth and disked in the spring, or it may be plowed in the spring and disked just before planting. North of the latitude of southern Iowa, spring planting is always to be preferred, while to the southward, orchards may be planted either in fall or spring. In the case of fall planting, two or three furrows should be turned towards the tree on each side of the row as a matter of protection from alternate thawing and freezing about the roots and to turn away surface water from the trunk.

In planting the tree it is essential that the first earth that is put in the hole should at once be tramped about the roots, and this process repeated as the hole is filled. Great care must be taken in this region to keep the trees from drying out in handling them while they are being transferred from nursery to orchard. Trees should be kept perfectly dormant till planted. Nursery stock should be neither accepted nor planted after its buds have started growth. Sometimes when such stock is transferred promptly from nursery to orchard on a rainy day, it may grow well, but as a rule it dies or makes but feeble growth.

Budded apple trees should not be planted in any part of the upper Mississippi Valley for the reason that when such trees are set in the orchard the point of union between the top and the seedling root comes at or near the surface of the ground, thus exposing the root to greater liability of suffering winter injury than when it is buried more deeply. By using a long cion grafted on a short piece-root, it is possible to produce a nursery tree that will permit of planting the seedling root deeply. During the history of apple-growing in the more northern parts of the mid-continental apple districts, it has repeatedly happened that when the hardier cultivated varieties have been budded on some tender seedling roots, the roots have been winterkilled, while the top remained uninjured until it died from the lack of live roots to support it. In many cases when root-grafted trees of the very hardy varieties had sent out roots from the lower part of the cion, they were able to withstand the severest winters uninjured, while trees of the same kinds which were not thus established on their own roots died from winterkilling of the roots. Such experiences have led fruit-growers to demand root-grafted apple trees.

The methods of spraying now being followed by the more intelligent and progressive apple-growers of mid-continental America do not differ materially from those of the best growers east and west.

Pruning.—Pruning is, generally speaking, sadly neglected by the ordinary apple-grower. In recent years, the tendency of orchard practice in the Mississippi Valley has been towards the methods of heading and pruning apple trees which are most commonly practised in the intermountain and Pacific coast districts. Very high-headed trees are comparatively scarce except in old closely planted orchards in which the lower limbs have been lost by over-crowding. The trees are headed rather low, commonly at about 18 to 24 inches from the ground to the first limb. The leader is taken out at a height of 28 to 36 inches, leaving for the framework of the tree from three to five ascending main limbs which should be at least 6 inches apart. In regions where the trees are comparatively short-lived or with varieties that are not expected to live more than from twenty to thirty years, this is doubtless the best practice, but with longer-lived trees it is open to the very serious objection that when loaded with fruit or weighted with ice and snow these large limbs sometimes break at the trunk, leaving an injury which can never be healed, and as a result the whole tree goes down within a few years. On the other hand, trees that are trained with a central leader may lose very large branches and yet heal over such wounds and live

to old age in good condition. In training trees in this way, it is best to cut off the leader at the proper height when the tree is planted. This tends to force the growth of the branches which are needed to form the main framework of the tree. One of these branches may be allowed to grow in the center of the top so as to form a new leader.

Aside from shaping the tree so as to give it right mechanical framework for supporting heavy loads of fruit, it needs to be kept sufficiently open to permit light and air to reach the foliage throughout the top. This will favor the best development of abundant and strong fruit-buds and perfect fruit. It also leaves the top open so that all of its foliage and fruit may be readily sprayed. Thick, dense tops are to be avoided and trees should not be allowed to grow so close together as to crowd each other.

Tillage.—As before stated, the best system for general practice in conserving soil moisture and fertility is tillage throughout the growing season, till late July or early August, followed by a good cover-crop. The greatest care must be used not to bruise the trees when cultivating. In this interior climate, it often happens that such wounds do not readily heal and they may result in the loss of the tree within a very few years. If a wound happens to be made, the loose bark should be at once cut away and the exposed surface coated with a thick paint of pure white lead and raw linseed oil and kept thus protected till completely healed over.

Mice and rabbits.—For the last few years in the writer's experience, lime-sulfur sprayed on the trunks and low branches of the trees as soon as the leaves drop has prevented attacks of mice and rabbits. Use at same strength as indicated for the dormant season.

Handling the crop.—At the present writing, the apple crop of the mid-continental regions is marketed locally, either in bulk, open packages, or in barrels, or it is shipped in barrels or in bulk. Box-packing is practically unknown here. It is just beginning to be practised by a few scattering enterprising fruit-growers. It would extend more rapidly but for the fact that very few persons in this region know how to pack apples in boxes. The Iowa Experiment Station has taken the lead in introducing box-packing among the apple-growers of the interior by arranging for schools of instruction in apple box-packing in that state and assisting in introducing them into other states. The effect of this work is already shown in the rapidly growing local interest in improved methods of grading and packing apples for market.

The methods followed in barrel-packing and in handling apples in bulk do not differ materially from those which are prevalent in the eastern states. So also the handling of apples in cold storage follows the general lines of this business as practised by eastern growers and dealers, but the storage facilities are not yet developed as extensively as in eastern apple-growing sections, although many strictly up-to-date storage establishments are found.

Fruit-growers' organizations.—There are as yet comparatively few apple-growers' organizations in this mid-continental region. Generally speaking, these are organized along lines similar to those which characterize the fruit-growers' organizations of the Rocky Mountain and Pacific coast states, except that in no case are they yet combined in a fruit-growers' exchange. With the increase of intensive orcharding, it may reasonably be expected that apple-growers' organizations in this region will become more abundant and more thoroughly systematized.

Orchard-heating.—The recent advent of the practice of fighting late spring frosts by orchard-heating undoubtedly marks a new era in fruit-growing in the mid-continental regions. It reduces the hazards by bringing an heretofore uncertain factor under some degree of control and thus puts the industry upon a more stable basis.

The amount of losses in this region during only the past decade from injury to orchard blossoms and fruits by late spring frosts and freezes aggregates an enormous sum, a considerable part of which doubtless might have been saved by proper orchard-heating. In the Iowa Horticultural Society Report for 1910, Laurenz Greene estimates the amount of loss from frost injury to the apple crop of Iowa alone from 1905 to 1910 at $5,000,000 to $10,000,000. In some of the other states, the losses have been even greater.

The practice of orchard-heating for this region is in many respects still in the experimental stages, and much will need to be learned before all the details shall have been definitely worked out into the most efficient and economical practice. Nevertheless, it may now rightly be regarded as a good method of insurance against frost injury.

For detailed treatment, see *Orchard Protection.*

S. A. Beach.

Apple-growing in the western mountain states.

Accepting the common geographical grouping of the states, the mountain division embraces the states of Colorado, Idaho, Montana, New Mexico, Utah, Wyoming, Arizona and Nevada. According to the census report, these states produced in 1909 a little less than 4 per cent of the total apple crop of the United States, or 5,500,000 bushels. While New York alone produced four times this amount, and the New England states more than 10,000,000 bushels, these mountain states are competitors worth considering in commercial apple-growing. In 1910, these states reported only 40 per cent of their total acreage of apple orchards in bearing, while the New England states, as well as New York, reported about 80 per cent of their apple trees of bearing age.

The mountain states.

In the two years that have passed since these figures were gathered, at least five of the mountain states have greatly extended the plantings of apple orchards, and it is safe to say that in no group of states is the apple industry growing more rapidly. Of this group, Colorado stands first in production, Idaho second, Utah third, Montana fourth and New Mexico fifth. In total acreage planted to apple trees, Colorado ranks first, Idaho second and Montana third. Colorado has a substantial lead and promises to hold its place for some years to come. Comparing Utah and New Mexico, it would be unsafe to say which leads in total acreage of apple orchards. The same is true of Arizona, Nevada and Wyoming. The fruit-growing industry of the region has grown up in comparatively recent years and, with the exception of Arizona and Nevada, all states reported the larger per cent of the apple trees too young to bear in 1910. The status of the apple-growing industry in these states individually may be briefly summarized as follows:

Colorado.—In 1910, Colorado reported 1,688,000 apple trees of bearing age and 1,973,000 trees not bearing. In 1909 the state produced, according to census figures, 3,559,000 bushels of apples. The state's principal apple-growing sections are the Grand Valley (Mesa County); the North Fork Valley (Delta County); the Uncompahgre Valley (Montrose County); the Cañon City district (Fremont County); and a new and promising district embracing a large part of Montezuma County. The varieties most largely grown are Gano, Jonathan, Rome Beauty and Winesap. In the older orchards, there has been a considerable planting of Ben Davis, but many of these are now grafted to the better varieties. Little is done in the way of apple-growing without irrigation. Most of the orchard land

is found in comparatively narrow mountain valleys or upon the bench or mesa lands of these valleys.

Idaho.—In 1910, Idaho had 1,006,000 apple trees of bearing age and 1,540,000 trees not bearing. The state is credited with the production of 660,000 bushels of apples in 1909. The Snake River Valley is the principal apple-growing section. In the north of the state, the Clearwater Valley and the valleys of the Kootenai and Clarke's Fork of the Columbia afford additional possibilities for commercial apple-growing. The industry is growing rapidly, and it is probably safe to say that in 1913 the output of the state was double that of 1909. The principal varieties grown are Gano, Jonathan, Winesap and Rome Beauty, with Esopus and Yellow Newtown in the newer plantings. In the northern half of the state, the moisture supplied by natural rainfall is generally sufficient to mature the apple crop, while in the southern half of the state additional moisture must be supplied by irrigation.

Montana.—In 1910, Montana had 697,000 apple trees of bearing age and 1,308,000 trees not bearing. The estimates of the State Board of Horticulture placed the total acreage of apple orchards in Montana, in 1912, as 30,000 acres. The principal apple-growing sections are the Bitter Root Valley, the Flathead district, which embraces a portion of the valley above Flathead Lake and the land along the lake shore, the Clarke's Fork Valley (Carbon County) and the Yellowstone Valley (Yellowstone County); with newer plantings in the valley west of the junction of the Missoula and Flathead Rivers (Missoula and Saunders Counties) and in the Tobacco Plains and Kootenai Valleys in Lincoln County. With the exception of the greater portion of the Flathead districts, all are irrigated. The principal varieties grown are McIntosh, Wagener, Rome Beauty, Northern Spy and Wealthy. A few Gano, Jonathan and Delicious are being planted. The Transcendent Crab, largely planted in the older orchards and those just coming into bearing, is being little planted now, on account of its susceptibility to pear blight.

New Mexico.—The apple industry of this state is comparatively young. In 1910 there were 543,000 trees of bearing age and 914,000 trees not bearing. In 1909, the state produced 417,000 bushels of apples. The orchards are all under irrigation and are located in the Rio Grande Valley from north of Albuquerque to the Texas line, in the Roswell district in the Pecos Valley, and in the Farmington district (San Juan County), which may be said to be a continuation of the Montezuma district of Colorado. The varieties grown are Ben Davis, Gano, Arkansas Black, Winesap, Jonathan, White Pearmain and Rome Beauty. The apple industry is growing rapidly, especially in the Roswell and Farmington districts. The state bids fair to take third place in the mountain region.

Utah.—In 1910, Utah reported 517,000 trees of bearing age and 789,000 not bearing. In 1909 the total apple-production was 350,000 bushels. In the past ten years the state has not shown the growth in apple-production as has Colorado, Idaho, Montana and New Mexico; yet many new orchards are being planted in the Cache Valley (Cache County), Bear Valley (Iron County), Utah Valley (Utah County), and in the Ogden district. These are the leading apple-growing sections of the state. Gano and Jonathan are most widely planted, although Winesap, Rome Beauty and and other standard winter varieties are grown in smaller quantities. The orchards are all irrigated.

Arizona.—Approximately 1,000 acres were in apple orchards in Arizona in 1910, about one-half being of bearing age. The climate over most of the state is too warm for the apple, and in the mountainous sections of the state where apples may be successfully grown, the areas which can be irrigated are very limited in extent. There is apparently little chance for development in commercial apple-growing.

Nevada.—With a climate similar to that of Arizona, the apple industry has not flourished in Nevada. Latest census figures credit the state with little more than 1,000 acres of apple orchards. Limited areas located near the Sierra Nevada Mountains in the northwest part of the state are fairly well adapted to apple-culture. The rainfall is light and all orchards are irrigated. A number of the standard winter varieties are grown.

Wyoming.—The interest in apple-growing in Wyoming is confined principally to the development of the home orchard. The acreage planted is about equal to that of Arizona or Nevada, with a little more interest now manifest in the development of the industry. The varieties planted are Wealthy, McIntosh and Jonathan.

General practices.

Generally speaking, this whole region is arid, little being attempted in the way of apple-growing except with irrigation. The atmosphere is dry, and during the summer months there is an exceptionally large amount of sunshine. Especially in the mountain valleys, the days are warm and the nights cool. The entire region is more or less subject to untimely spring frosts. For this reason many of the best fruit sections of the region are found in narrow mountain valleys, protected more or less by cañon breezes, or upon the bench lands of broader valleys, where the air drainage is good. Within this region, however, we find many sections afforded this natural protection where the apple crop seldom fails.

Soils.—Within this group of states, apples are grown on a large variety of soils. The great majority of orchards have been planted upon virgin land, and as time goes on, we shall probably learn to consider soil-adaptation a more important factor in apple-growing. From the standpoint of ease of cultivation, ease of irrigation and the maintenance of soil fertility, the medium sandy loams are proving the most satisfactory apple soils.

Tillage.—The orchardists of the mountain states have from the beginning been exponents of clean culture. In many sections, however, they are now beginning to feel that this has been overdone, and in the present system of tillage, clean cultivation and cover-crops alternate. In some cases the orchard is well tilled during the early part of the season and seeded to field peas, vetch or other crop in midsummer. Another practice is to seed the orchard to clover, which is turned under after two seasons' growth. The orchard is then cultivated for one or two seasons and again planted to clover. Alfalfa has been used instead of the clover. Providing it is kept away from the trees and within reach of the turning plow, alfalfa is not objectionable in orchard lands free from stones. On rocky land it is difficult to kill the alfalfa out. In this arid region, some such system of tillage must be practised as a means of maintaining soil-fertility.

Irrigation.—The irrigation practice of the orchardists of these states is not unlike that of the other western states. Practically all water is applied by the furrow method, running shallow ditches close together in sandy soils and deep ditches farther apart in the heavy soils. The distances between ditches will vary from 2 to 6 or 8 feet. The old orchards receive from two to four applications during the growing season. The plan is to get the fruit up to size early in the season and then promote coloring by maintaining only a moderate moisture supply during the latter part of the summer. In sections where the winters are dry, both the old and young orchards receive one late fall irrigation This is applied after the first frosts when there is no longer danger of starting new growth. The young orchards are well watered during the early part of the growing season. After midsummer, little water

is applied. Every effort is made to check the growth of the trees early, for when well matured they withstand severe freezing best.

Pruning.—The apple-growers of the mountain states are quite unanimous in their choice of the vase-form as the standard to be worked for in training apple trees. While the eastern grower many justly condemn such a system of training on account of limited fruiting area, the objection is without merit in this region where the tendency is for most varieties to overbear. In the first three or four years in the orchard, the young trees are severely headed-in each spring, the object being to get a stocky trunk with the first scaffold limb within 12 or 18 inches of the ground and three or four more spaced along the trunk at intervals of 6 inches. After these first three or four prunings, little heading-in is done until the trees begin to overbear. The trees are then cut back and thinned out sufficiently to induce annual bearing and the production of fruits of desirable sizes with the minimum amount of hand thinning. In the commercial fruit-growing sections, the fruit is systematically thinned. There is little occasion for summer pruning.

Marketing.—The bulk of the apple crop of these states is sold in standard apple-boxes, and much of the fruit is wrapped and packed in sizes in tier packs. As a rule, the fruit is marketed through coöperative fruit-growers' associations, some of the oldest and most successful associations in the United States being found in this region. The fruit is generally distributed in all eastern, southern and western markets where extra fancy boxed apples are in demand.

Diseases and insects.—The apple-growers of the mountain states are little troubled with fungous diseases. During the summer season the atmosphere is generally dry and the fungi apparently do not thrive. In some of the more humid sections of this region, especially in rainy summers, apple scab becomes a serious menace. It is easily controlled, however, with the lime-sulfur sprays. Over the entire region, pear blight has attacked some of the more susceptible varieties of apples. The planting of Alexander and Transcendent Crab has been discontinued on this account, and in some sections other varieties must be watched carefully and will probably be discarded eventually.

Of the apple orchard insects, the codlin-moth is easily the most important, and over almost the entire region up-to-date methods of control must be employed. Both the green and woolly aphis are ever-present enemies of the apple orchards, the first troubling young orchards especially. The San José scale has not as yet become a troublesome pest in the apple orchards of the greater part of the mountain region. The oyster-shell scale, the bud-moth and the green fruit-worm are of only local importance.

The majority or orchardists of this region are well equipped with modern power spraying machinery, and as a rule are well posted on spraying methods.

O. B. Whipple.

The apple in Oregon and Washington.

The states of Oregon and Washington are noted for their diversity of fruit conditions. Their soils range from the lightest loam to the heaviest adobe; their rainfall varies from 8 or 9 inches to over 100; their elevations extend from sea-level to the snow line. From the horticulture of each of these states, which is thoroughly described in this Cyclopedia, the readers can get complete details concerning these special characteristics.

In Oregon apple-culture is largely confined to such valleys as the Rogue River, Umpqua, Willamette, Hood River, Freewater-Milton, and Grande Ronde, with certain developments along the coast, especally in such regions as Coos Bay.

In Washington the development is largely east of the Cascade Range in such inland districts as Wenatchee, Yakima, Walla Walla and Lewiston-Clarkston.

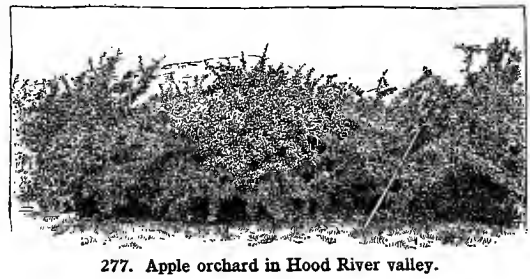
General considerations.

Apple-culture on the Pacific Coast is characterized by the following:

Communal development.—In such valleys, for example, as the Hood River (Fig. 277) or Wenatchee, one finds that apple-growing is almost the sole industry, and large contiguous areas are devoted to apple-production alone. One sees the entire absence of diversity of agriculture in some districts. These orchards may occasionally be very large, although in the more highly developed regions the tendency is for small orchards very intensively developed.

Intensive tillage.—There is practically not a fruit-grower to be found on the Pacific Coast who is not a firm believer in tillage. In a few sections, the introduction of shade-crops is supplementing the former intensive tillage, but the almost universal practice is to till very intensively.

Systematic spraying.—Each orchard is given frequent sprayings, according to a specified program. There are very few orchards on the Pacific Coast that are not equipped with power sprayers, capable of maintaining 200 pounds of pressure. Pacific Coast apple-growers are thoroughly alive to the value of spraying for pests.



277. Apple orchard in Hood River valley.

Methodical thinning.—It would be very hard indeed to find any fruit districts in which the orchardists do not thin regularly. They would no sooner give up thinning than eating. It is thought by a great many growers that thinning pays a larger dividend on the investment than any other orchard practice.

Skillful packing.—The Pacific Coast has long been famous for the high-grade packing of its fruit products. Every effort is made to educate the growers to be skillful fruit-packers, and rigid systems of inspection are maintained in order that the high grade of the pack may not be sacrificed.

Spirit of coöperation.—Almost every community is thoroughly organized. The spirit of coöperation has taken a firm hold with the people and its benefits are thoroughly realized. Not only have certain sections organized, but there is every indication at the present time that within the next few years apple interests of the entire Pacific Coast will be consolidated into a central selling agency.

The personnel of the Pacific Coast fruit-growers can be characterized by the large number of young men, especially college graduates, who are engaging in apple-culture. In Hood River alone there are in the neighborhood of one hundred and thirty college graduates from all parts of the country engaged in apple-growing and making it a life-work and study. There are also large numbers of retired business and professional men from various parts of the country. Such men, because of their enthusiasm, are anxious to adopt up-to-date methods in order to make very successful fruit-growers. They intend to specialize in making apple-growing a very serious business. It is not an uncom-

mon thing to find a man devoting his entire energy to the growing of two varieties of apples.

Orchard management.

Most of the orchardists practice annual spring plowing. In some of the lighter soils, disking takes the place of plowing, but the present tendency is to plow and harrow down the soil very thoroughly. With the heavy loams the plowing is generally followed by light harrowing, supplemented by the use of the clod-masher, corrugated roller or brillion. After the ground is placed in good condition, frequent cultivations are made. One of the best tools to use in such cases is the Kimball weeder; this stirs the soil and prevents drying or baking of the surface soil. Often as many as eighteen harrowings are given during the summer-time. By the middle of August or at such time as the young trees have made sufficient growth, cultivation ceases, but with the heavier-bearing orchards cultivation is generally continued up to the harvesting. With the lighter soils, such as many of the volcanic ash, after the ground has been plowed in the spring, the tendency is to compact the ground more by the use of subsoil packers or by dragging the ground with floats. Such soils tend to blow out constantly and it is only by these methods that the moisture can be retained in the surface soil.

Irrigation.—Irrigation becomes more and more a factor to the Pacific Coast apple-grower east of the Cascade Mountains where the rainfall is less than 15 inches. Irrigation is made to supplement tillage. The water is applied by the furrow or rill system, and as soon as possible after irrigation the ground is thoroughly harrowed and, after becoming smooth, is kept in good shape with smoothing harrows. Irrigation is practised more with trees fifteen years of age and up than with young trees.

The growers are finding out that an abundant supply of moisture either through intensive tillage or irrigation tends to make the trees produce larger crops, makes them annual bearers, increases the individual size of the specimens and tends to make the fruit more elongated and of a livelier, brighter color. In some cases too much moisture is used, resulting in soft, poorly colored fruit of poor shipping qualities.

Fertilizers.—At the present time no commercial fertilizers are being used. The growers, however, are taking hold of cover-crops very enthusiastically. Vetch becomes a principal crop,—the forage or Oregon vetch in the region where the climate is mild, and the hairy vetch where the climate is severe. The vetch is generally combined with rye, oats, or wheat, and is drilled in by the latter part of August, about forty pounds of vetch and ten pounds of rye being the common amount to use to the acre. Under normal conditions, from 2 to 3 feet of growth can be realized by early spring.

Shade-crops.—In the irrigated sections where the tendency to use shade-crops is becoming common, alfalfa and the clovers are the principal crops grown. There is a great difference in opinion among the growers whether alfalfa is a suitable crop to use as a shade-crop, clovers being more commonly used. Some growers practise growing clover for two years, cutting it and allowing it to mat on the ground; while other growers disk the clover under each year and allow it to reseed itself. The practice of growing shade-crops is yet so new that it will be a number of years before the growers unite on some practice, but a larger percentage of growers are resorting to shade-crops each year.

Thinning.—Nearly all varieties of apples are thinned very carefully. The thinning generally begins as soon as the drop is over, in some places before the drop takes place. The apples are thinned at various distances, according to varieties. The red apples are generally thinned one to a spur. With yellow apples, there is a tendency to leave two specimens on certain spurs but to remove all the fruit from the remaining spurs. The growers think that when this method is followed there is a tendency to maintain the trees as annual bearers. The distances apart vary extremely. Winesaps are thinned from 8 to 10 inches apart, whereas the larger varieties of apples are thinned rather sparingly, as they often have a tendency to overgrow if thinned too vigorously.

Pruning.—Most growers practise annual pruning. The trees are started very low, the head being 9 to 18 inches from the ground. Most of the growers resort to what is known as the open, goblet or vase tree. In this tree, most of the branches issue from one point and the trees are kept open constantly by rigorous pruning. The growers think that more light is allowed to play around the fruit by such a system and that a better color is developed. During the first three years, the trees are cut back very rigorously each spring, but as they become older less heading-back is resorted to and more thinning-out is practised. Many of the growers are now leaning more to the modification of the center tree, growing what is known as the modified center tree, the leaders being allowed to grow for a few years and then being suppressed. This system gives a better distribution of the branches and makes a stronger tree, and it also gives a larger fruiting area. Some growers contend that varieties like the Yellow Newtown do better if trained as leaders.

There is much sentiment among the fruit-growers on the Pacific Coast in favor of summer pruning. In their enthusiasm, many of them are overdoing summer pruning. On the stronger loams certain varieties like Yellow Newtown are slow in coming into bearing, but on the lighter loams and higher altitudes come into bearing in three to five years. In such cases summer pruning is not resorted to.

Pollination.—Pollination has become a subject to which the Pacific Coast growers are paying a great deal of attention and the orchards are now being planted in oblong blocks of two to six rows of a variety. It is felt that where this is practised, a larger set of fruit is secured, that there is a greater uniformity in the crop and a tendency for increase in size of specimens. Formerly trees were planted in large blocks, but the heavy shedding of fruit has caused the growers to abandon this system and plant so that interpollination can take place.

Frost-fighting.—Frost-fighting is resorted to in many of the mountain valleys that are early and subject to damage from frosts. The most common method for controlling is smudging with oil in pots. The last few years many growers have been very successful in saving the crops under adverse conditions. See *Orchard Protection.*

Spraying.—Practically every grower has a spray calendar which he follows very carefully. Power outfits are used extensively and high pressure is maintained. In all the older orchards, high platforms are built on the spray outfits so the trees can be thoroughly covered with spray. The principal diseases are the mildew, found more in California and southern Oregon; apple scab; apple tree anthracnose, or black spot. These are about the only diseases that receive much attention. Of the insect pests, the codlin-moth and aphis are the most serious. The codlin-moth is distributed over the entire district with the exception of the coast regions, which are free from this insect pest. The green aphis attacks the young trees injuriously, and for the past two years the brown aphis has been of serious menace to the fruit. In some regions the brown aphis is now doing more damage than the codlin-moth. The scale insects, for the present time, receive very little attention, as they are so easily controlled. Occasionally the red-spider and borers give considerable trouble.

Packing.—The apples are all packed in boxes known as the Northwest Standard, 10½ x 11½ x 18 inches.

All the better grades of apples are wrapped in paper, and lithographs are placed on the boxes. The fruit is graded very carefully before packing. The present tendency is to use one size of box and pack the apples by what is known as the diagonal pack.

Packing-houses.—Very large and expensive packing-houses are being erected all over the Pacific Coast and enormous storage plants are being built at all the immediate shipping points. In most cases, the packing is very rigorously inspected. Most of the states have laws that require the grower to put on the box his name, the grade of fruit and the number of specimens in the package. Most associations require the packer to stamp his number on the box, so that in the case of any imperfections it can be easily traced.

Marketing.—The marketing of the fruit is done largely through associations. By coöperating, the growers have been able to improve constantly their pack and have also tended to distribute the fruit more widely. At the present time, the Pacific Coast is sending fruit to nearly all the leading ports of the world, and the effort is made to get a wider and wider distribution rather than to send it to a few distributing points like Chicago and New York, which was the system formerly followed.

The willingness of the people to organize, and the coöperative system, which is broadcast in the region, is a very important factor in successful apple-culture on the Pacific Coast. C. I. Lewis.

The apple in California.

Although the apple was introduced into southern California by the Mission padres nearly a century before the American occupation, and although the Russians established an apple orchard in northern California more than a quarter of a century before the gold discovery, it was not fully demonstrated until about 1880 that the state can produce an apple of character and quality to entitle the region to standing among

278. A California apple orchard.

the commercial apple regions of the United States. California pioneers were accustomed to concede apple adaptations to Oregon and to claim none for themselves. This was chiefly due to the fact that early plantings were made in the mining districts of the lower foothills and on valley lands adjacent to routes of travel thereto from the port of San Francisco. Climatic conditions in such situations forced too early maturity of winter varieties, which impaired quality and keeping and, as main commercial desirability was vested in long-keeping, California was conceded to lack adaptations for the production of a good apple, and local supplies of the fruit were drawn for three decades from the orchards in western Oregon. Popular judgment was, however, reversed by the notable long-keeping of California apples shown at the New Orleans Fair in 1885, which is explained by the fact that the exhibits were gathered from family orchards in the coast districts and in the high plateaus and mountain valleys where growing conditions are quite unlike those of the lower foothills and adjacent valleys. The conclusion from this demonstration was that when the right variety is planted in the right place, in California, superior fruit, both for local use and long shipment, may be secured. Since that time, California apples have been successfully sold in considerable quantities in England and on the continent of Europe, on the Atlantic Coast of America, in Australia and in Eastern Asia—as well as throughout the interior states of the Pacific Slope, in Canada and in Alaska. The uprise of a great apple industry in other states of the Pacific Slope has, however, recently excluded the California winter apple from large American areas in which it formerly sold freely, but California still retains in the same areas its market for summer and fall apples because mature fruit can be shipped before the same varieties ripen farther north or at greater elevations. Fig. 278 shows a representative California apple orchard.

Summer apples.

It is now clear that there are two distinct branches of the apple industry of California, in which, first, effort is concentrated on the production of summer apples in what are known as early districts and, second, fall and winter apples in other districts where slower development is favored by prevalence of lower spring and summer temperatures. In the interior valleys and lower foothills, the forcing heat brings early varieties, like the Astrachans, quickly to notable size, crispness and flavor, and there is an ample demand for such fruit for shipment, providing it is sound and free from pests, some of which, however, are more aggressive than they are in cooler sections. Fall apples are successfully grown in the same districts but they also are profitable in the coast district, as is shown by the behavior of the Gravenstein in the Sebastopol section of Sonoma County where "Gravenstein shows" are annually held in August. Another instance of specialization is found in the commercial importance of the Yellow Bellflower in the Watsonville district, where it enters largely into the "Apple Annual"—a greater exhibition held the first week in October. In these typical fall-apple districts, the winter apples are also important, the Esopus (Spitzenberg) leading these varieties at Sebastopol and the Yellow Newtown at Watsonville. These facts emphasize the importance of certain varieties; for specialization is built upon varieties even more than upon the classes to which they belong.

Winter apples.

The chief importance does, however, rest with the winter apple in California, in the same way, but perhaps not to such a degree, as in other apple-growing states and countries, and the chief investment and expectation are made upon that basis. Aside from the conditions cited, which make nearly exclusively for the summer and early fall varieties, the state has great capacity for the production of winter apples of the type for which the coast has become so famous during the last few years. Every county in the state has apple trees, but the requirements of a winter apple are fully met by two main divisions of the state, viz.: the smaller valleys close to the coast, in fact, in some cases, the coast flats, where the exposure is directly toward the cooling breezes of the ocean which produce a cool summer—a long, slow-growing season, which develops great beauty and high quality in a winter apple. Similar results are also produced by the climate found at an elevation of about 2,500 to 5,000 feet on the interior plateaus and in the mountain valleys. The coast district has developed a greater commercial apple industry than the mountains, because transportation facilities for shipment are vastly better; but as the state advances, the mountain

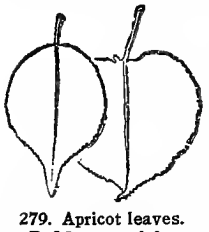
districts will be employed in this production much more largely than at present. The greatest apple district of the state now is the Pajaro Valley, including parts of Monterey and Santa Cruz Counties, centering at Watsonville, which shipped about 6,000 carloads of apples in 1912. The county next prominent in apple-growing is Sonoma; Santa Cruz and Sonoma Counties have about one-half of all the trees in the state, while many other counties have good apple orchards in less total acreage; in fact, from San Diego on the south to Siskiyou on the north, localities exist which afford the elevation or the coast exposures that favor the production of good winter apples, and planting is progressing in all these districts.

Extent.

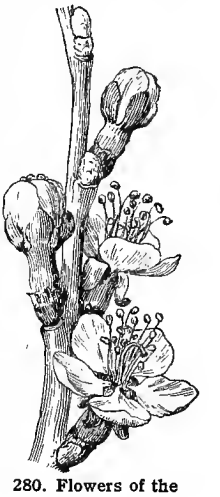
The number of apple trees in California in 1913 is about 2,500,000, occupying, as nearly as can be calculated, 30,000 acres of land. The varieties of chief commercial importance, in order of ripening, are: White and Red Astrachan, Gravenstein, Yellow Bellflower, Yellow Newtown, Esopus, White Pearmain, Winesap and Rome Beauty. Many other winter varieties have been planted recently in different districts, but their relative importance cannot be predicted. E. J. WICKSON.

APRICOT. *Rosàceæ.* A tree and fruit somewhat intermediate between the peach and the plum, grown largely in California and in special localities in the East.

The apricot tree is a round-headed grower, with dark, somewhat peach-like bark, and very broad or almost circular leaves. The fruit, which usually ripens in advance of both the peach and plum, is peach-like in shape and color, with a smoother skin, rich yellow flesh and large flat smooth stone. The flesh is commonly less juicy than that of the peach, and, as a rule, perhaps, of higher quality. The apricots are of three species, all probably native of China or Japan. (1) The common apricot of Europe and America is *Prunus Armeniaca:* fr. variable, but smooth at maturity, red or yellow, the sweet and firm flesh free, or very nearly so, from the large, smooth, flat stone: tree with a round, spreading top, and a reddish, cherry-like or peach-like bark: lvs. (Fig. 279, right) ovate or round-ovate, with a short point and sometimes a heart-shaped base, thin and bright green, smooth or very nearly so below, as are the gland-bearing stalks, the margins rather obtusely and mostly finely serrate: fls. pink-white and borne singly, sessile or very nearly so, preceding the lvs. (Fig. 280). The Russian apricot is a hardy but smaller-fruited race of this species. (2) The Japanese apricot, in Japan grown for flowers rather than for fruit, is *Prunus Mume:* fr. small, yellowish or greenish, the flesh rather hard and dry, and adhering tightly to the pitted stone: tree like the common apricot, but with a grayer or greener bark and duller foliage: lvs. grayish green, generally narrower (Fig. 279, left) and long-pointed, more or less hairy along the veins below and on the shorter mostly glandless stalk, thick in texture and prominently netted beneath: fls. fragrant, borne singly or in 2's, and sessile (without stalks); more lately intro. into this country, chiefly under the name of Bungoume plum. (3) The third species is the purple or black apricot, *Prunus dasycarpa,* which is little cult.: fr. globular and somewhat plum-like, with a distinct st., pubescent or fuzzy even at maturity, dull dark purple, the sourish soft flesh clinging to the plum-like fuzzy stone: tree round-headed, with much the habit of the common apricot, with lvs. ovate and more or less tapering at both ends, thin, dull green, on slender and pubescent, mostly glandless, stalks, finely appressed-serrate and hairy on the veins below: fls. large and plum-like, blush, solitary or in 2's, on pubescent stalks ½in. or more long, and appearing in advance of the leaves. See *Prunus* for related species. The apricot-plum, *Prunus Simonii,* is discussed under *Plum.* The plumcot is a hybrid of plum and apricot, accounted for under *Prunus.* L. H. B.



279. Apricot leaves. P. Mume on left; P. armeniaca on right.



280. Flowers of the apricot.

East of the Mississippi the apricot is not grown commercially to great extent, although it is a popular fruit for the home orchard and garden. As a commercial crop, it does not seem to be increasing in favor. There are two important reasons for this: the loss of the fruit by spring frosts because of the very early season of bloom, and the great liability to curculio attack. Possibly the apricot has not yet been given a thorough test. Its value may be more appreciated and the difficulties of its culture lessened when the fruit has received greater study and attention.

The apricot is as hardy as the peach and thrives in similar localities and under the same general cultivation and treatment, but demands very strong soil. The ideal land for this fruit seems to be one that is deep and dry, and loamy or gravelly in character. The rolling loamy lands that are well adapted to apples seem to be well suited to the apricot, if the exposure and location are correct. The apricot is particularly impatient of wet feet, and many of the failures are due to retentive subsoils. The kind of soil has an important bearing also on the stock to be used.

Particular attention should be given to the location and exposure of the apricot orchard. In the East the best results are secured if the plantation stands on elevated land near a large body of water, for there the spring frosts are not so serious as elsewhere. Generally a somewhat backward exposure, if it can be had, is desirable, to retard blooming. Apricots will be sure to fail in frosty localities.

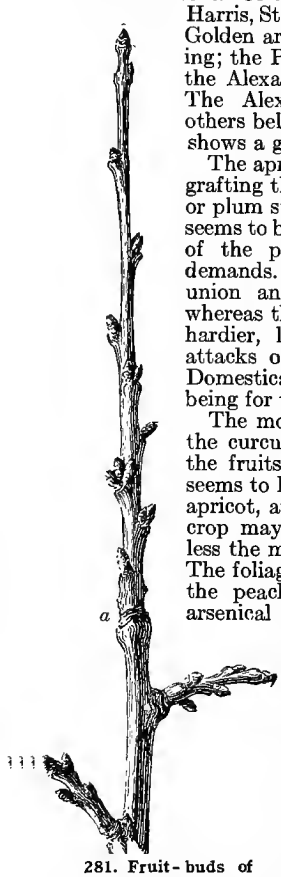
The apricot should always be given clean culture. For the first two or three years, some hoed crop may be grown between the rows, but after that the trees should be allowed the entire land, particularly if set less than 20 feet apart. Tillage should be stopped late in summer or early in fall to allow the wood to mature thoroughly. It is best to raise a cover-crop in the latter part of July or in August to hasten this maturity and also to protect the roots and to improve the physical properties of the soil.

The trees are pruned in essentially the same way as plums. The fruit-buds are borne both on spurs (two are shown in Fig. 281) and also on the wood of the last season's growth on either side of the leaf-bud, as shown in the twin and triplet buds above *a* in Fig. 281. Each bud contains a single naked flower (Fig. 280). As the fruit begins to swell, the calyx-ring is forced off over the top (Fig. 282) and the injury from curculio may then be expected. The fruit is often borne so close together as to appear to be in clusters (Fig. 283).

When grown under the best conditions, the apricot may be considered to be nearly or quite as productive as the peach. Like other fruit trees, it bears in alternate years, unless the crops are very heavily thinned. It can never be recommended for general or indiscriminate planting. Only the best fruit-growers can succeed with it. Apricots are to be considered as a dessert or

fancy fruit, and therefore, should be neatly packed in small and tasty packages.

The varieties mostly in demand in the eastern states in order of preference are: Moorpark, Harris, Alexis, Montgamet, Budd, Early Golden, St. Ambroise, Alexander and Peach. The Royal and Superb are grown to some extent. Of the above-mentioned varieties, the Harris, St. Ambroise, Montgamet, and Early Golden are early as regards season of ripening; the Peach and Moorpark are medium; the Alexander, Alexis and Budd are late. The Alexander, Alexis, Budd and some others belong to the Russian race. Fig. 284 shows a good-shaped apricot.



281. Fruit-buds of the apricot. Borne beside the leaf-bud, as on the peach, and also on spurs.

The apricot is propagated by budding or grafting the desired varieties on the peach or plum stock. On its own root the apricot seems to be less successful, probably because of the peculiar soil-requirements that it demands. The peach seems to give a better union and consequently a better stand, whereas the plum stock gives a tree that is hardier, longer lived, and less subject to attacks of borers. Both Myrobalan and Domestica stocks are used, the preference being for the latter.

The most serious enemy of the apricot is the curculio, the same insect that attacks the fruits of plum and peach. This insect seems to have a particular fondness for the apricot, and as the fruit sets very early, the crop may be expected to be destroyed unless the most vigilant means are employed. The foliage of the apricot, as in the case of the peach, is especially sensitive to the arsenical sprays and therefore entomologists have hesitated to recommend paris green and arsenate of lead for the control of the curculio. The work of W. M. Scott and A. L. Quaintance, of the United States Department of Agriculture, has shown, however, that arsenate of lead in combination with self-boiled lime-sulfur is successful in controlling this pest on the peach. It is probable that the mixture will be equally successful in controlling the curculio on the apricot. They recommend the use of two pounds of arsenate of lead combined with fifty gallons of self-boiled lime-sulfur applied as follows:

First application.—About the time the calyces, or shucks, are shedding from the young fruit.

Second application.—Two or three weeks later, or about one month after the falling of the petals.

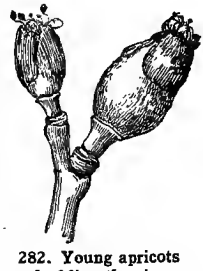
Another method of control of this insect is by jarring the trees, in the same way as with plums and peaches, but the work must be even more thoroughly done than with those fruits. The jarring should begin as soon as the blossoms fall, and continue as long as the insects are numerous enough to do serious damage. It will usually be necessary to catch the insects for three to six weeks, two or three times a week, or perhaps even every day. The work must be performed early in the morning, while the curculio is indisposed to fly. The operation consists in knocking the insects from the tree by a quick jar or shake, catching them on a white sheet or in a canvas hopper. The catcher formerly used in western New York was a strong cloth hopper mounted on a wheelbarrow-like frame, and run on two wheels. The hopper converged into a tin box, into which the curculios rolled as they fell on the sheet. One man wheeled the device, by barrow-like handles, under the tree, then dropped the handles and jarred the tree; or sometimes two men went with a machine, one wheeling it and the other jarring the trees. If the work of spraying, as above recommended, is done thoroughly, it will probably not be necessary to use this jarring device in addition; and the device is now going out of use.

The apricot is often trained on walls, where the fruit reaches the highest perfection. Care should be taken that the wall does not face the east or the south, or the early-forced flowers may be caught by frost. An overhanging-cornice will aid greatly in protecting from frost.

C. S. Wilson.†

The apricot in California is one of the leading commercial fruits. It was apparently introduced by the Mission Fathers, for Vancouver found it at the Santa Clara Mission in 1792. However, there is no relation between this early introduction and the expansion that quickly followed the American occupation, because the Mission Fathers had only seedling fruits, while the early American planters, shortly before the gold discovery, introduced the best French and English varieties, and were delighted to find that these sorts, usually given some protection in the Old World, grew with surprising thrift of tree and size of fruit in valley situations in California in the open air. Upon these facts the apricot rose to wide popularity. The acreage has steadily increased during the last fifty years, and with particularly swift rate during the last twenty years, until the number of trees reported in 1899 was about three millions, occupying upwards of forty thousand acres of land. Since then, however, the acreage has not increased, because the crop is irregular on account of frost injuries in some districts. The fruit is sold fresh, canned, dried and in crystallized forms, in all the regions of the United States, in England and on the Continent, where, by reason of its superior size and acceptable manner of curing, it has achieved notable popularity. The year 1905 was the greatest thus far in amount of dried product realized, viz., 36,000,000 pounds. The year 1911 was greatest in amount of canned product, which reached upwards of 758,325 cases, each containing two dozen 2½-pound cans. The shipment of fresh apricots out of California during the summer of 1910 was 290 carloads.

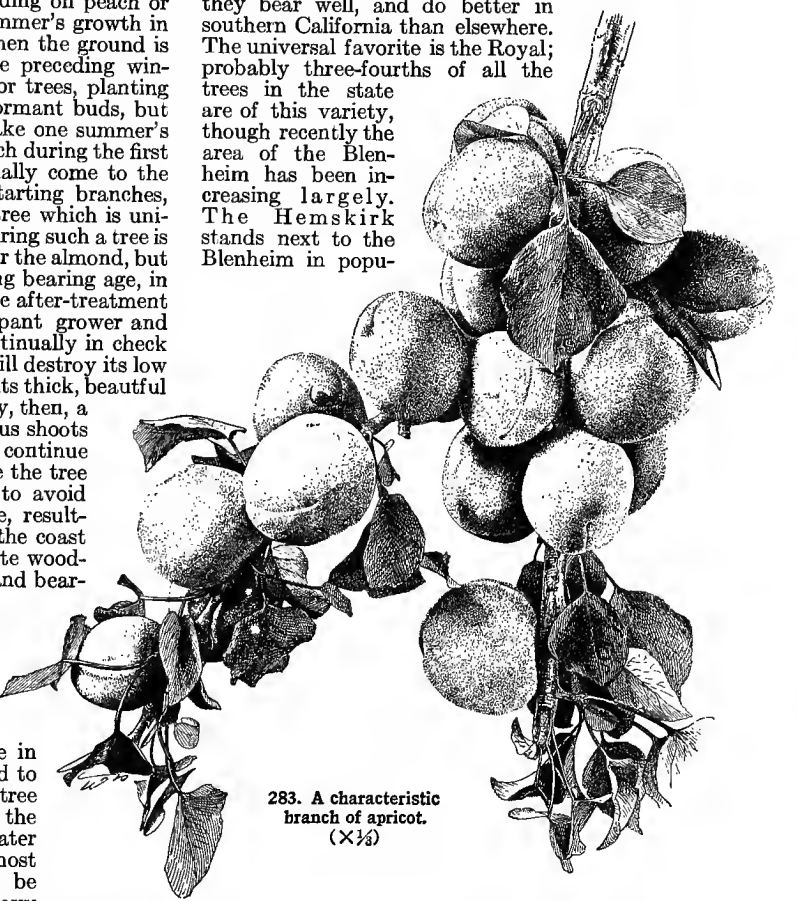
The chief part of the apricot crop of California is grown in the interior valleys. In the low places in these valleys, however, the fruit is liable to be injured and sometimes almost wholly destroyed by spring frosts, although the trees make excellent growth. In foothill situations adjacent to these valleys, there is also serious danger of frost above an elevation of about 1,500 feet above sea-level, and the tree is rarely planted for commercial purposes. In southern California the apricot succeeds both in the coast and interior valleys. But along the coast northward, excepting the very important producing regions of the Alameda and Santa Clara valleys, eastward, and southward from the Bay of San Francisco, the apricot is but little grown, owing to frost troubles. In respect to these, the apricot is somewhat less subject to harm than the almond, but it is less hardy than the peach, and has, therefore, a much narrower range of adaptation. The average date of the blooming of apricot varieties is about two weeks later than that of the almonds. The apricot is adapted to a wide range of soils, because to the rather heavy, moist loams which its own root tolerates, it adds the lighter tastes of the peach root, upon which it is very largely propagated. However, attempts to carry the apricot upon heavier, moister soils by working it upon the plum root have not been very successful, owing to the dwarf-


282. Young apricots shedding the ring.

ing of the tree; and the movement toward the light, dry loams, by working upon the almond root, has failed because the attachment is insecure, and the trees are very liable to be snapped off at the joining, even though they may attain bearing age before the mishap occurs. The apricot root itself is a favorite morsel with rodents, and is for that reason not largely used. The mainstay for the apricot, then, is the peach root, and the soils which this root enjoys in localities sufficiently frost-free are, therefore, to a great extent the measure of the apricot area.

Apricot trees are produced by budding on peach or apricot seedlings during their first summer's growth in the nursery row, from pits planted when the ground is moist and warm, at any time in the preceding winter. When there is a great demand for trees, planting in orchard is sometimes done with dormant buds, but ordinarily the trees are allowed to make one summer's growth in the nursery. The trees branch during the first year's growth from the bud, and usually come to the planter with a good choice of low-starting branches, from which to shape the low-headed tree which is universally preferred. The method of securing such a tree is identical with that already described for the almond, but the treatment of the tree after reaching bearing age, in its third year, is very different from the after-treatment of the almond. The apricot is a rampant grower and most profuse bearer. Unless kept continually in check it will quickly rush out of reach, and will destroy its low shoots and spurs by the dense shade of its thick, beautful foliage. There is continually necessary, then, a certain degree of thinning of the surplus shoots and shortening of the new growth, to continue the system of low branching, to relieve the tree from an excess of bearing wood, and to avoid small fruit and exhaustion of the tree, resulting in alternate years of bearing. In the coast regions, where the tree makes moderate wood-growth, it can be kept in good form and bearing by regular winter pruning. In warmer regions, where the tendency is to exuberant wood-growth, the main pruning is done in the summer, immediately after the fruit is gathered. This has a tendency to check wood-growth and promote fruit-bearing, and where the main cutting is done in the summer, winter pruning is reduced to thinning out shoots, to prevent the tree from becoming too dense and to lessen the work of hand-thinning of the fruit later on. In addition, however, to the most intelligent pruning, much fruit must be removed by hand when there is a heavy set of it, in order to bring the fruit to a size satisfactory to shippers or canners, and to reach the highest grades, if drying is practised. California apricot orchards are all grown with clean tillage, for the main purpose of moisture conservation. In regions of good rainfall and sufficiently retentive loams no irrigation is required; good tillage will suffice for the production of large fruit and perfection of fruit-buds for the following year. As the trees are becoming older and bearing larger crops the demand for moisture increases, and the use of irrigation water is growing. In most places, however, one irrigation is sufficient, and that is given after fruit-gathering, to carry the tree through the last half of its season's work. In the regularly irrigated regions of the state, water is periodically applied through the growing season, in such amount and at such intervals as the local climate and soils require.

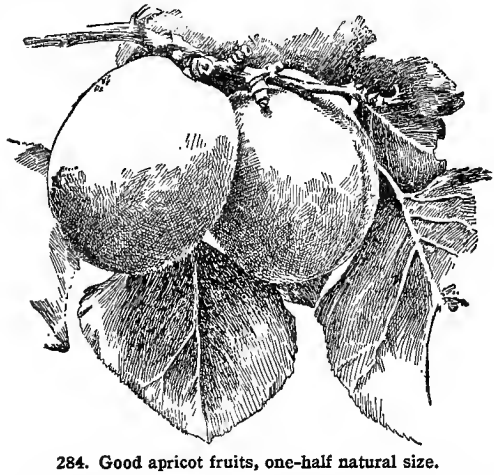
Although probably all the good varieties of the apricot in the world have been introduced into California in the last half-century, and scores of selected seedlings of local origin have been widely tested, the varieties that have survived the tests and are now widely grown are comparatively few in number. Most of the rejected varieties met this fate because of shy bearing, and those which now constitute the bulk of the crop are very regular and full bearers, under rational treatment. A local seedling, the Pringle, was for many years chiefly grown for the earliest ripening, but this has recently been largely superseded by another local seedling, the Newcastle, which is of superior size and about as early. The European varieties, Large Early and Early Golden, are fine in a few localities where they bear well, and do better in southern California than elsewhere. The universal favorite is the Royal; probably three-fourths of all the trees in the state are of this variety, though recently the area of the Blenheim has been increasing largely. The Hemskirk stands next to the Blenheim in popularity. The Peach is largely grown in the Sacramento Valley. The best apricot grown in California is the Moorpark; in size and lusciousness, when well ripened, it heads the list. It is, however, rather shy in bearing, and is forsaken for this fault in most regions. It shows the best behavior in the Santa Clara Valley, and is there retained, in spite of frequent lapses, because of the high prices which it commands at the canneries. About a dozen other varieties are carried in small number by the nurserymen to meet limited local demands.



283. A characteristic branch of apricot. (×⅓)

Apricots for canning and drying are graded according to size: Extra, not less than 2¼ inches in diameter; No. 1, 2 inches; No. 2, 1½ inches; No. 3, 1 inch. The first three grades must be sound, clean and free from blemish, and No. 3 must be of good merchantable quality. The shippers and canners require well-colored but only firm-ripe fruit, because both the long rail transportation and the canning process require it; soft-ripe fruit will neither can nor carry. For drying, riper fruit is used, and yet over-ripeness has to be guarded against to avoid too dark color. For canning, the fruit must be carefully hand-picked; for drying, much is shaken from the trees. The drying process consists in cutting

the fruit in halves longitudinally, dropping out the pits and placing the halves, cavity uppermost, upon light wooden trays. Breaking or tearing the fruit open will not do; it must show clean-cut edges. When the trays are covered they are placed in a tight compartment, usually called a "sulfur box," though it may be of considerable size, and the fruit is exposed to the fumes of slowly burning sulfur, to ensure its drying to the light golden color which is most acceptable to the trade. The production of the right color is the end in view, and different dryers regulate the amount of sulfur and the length of exposure according to the condition of their fruit and their judgment of what it needs. The exposure varies from half an hour to two or three hours, according to circumstances. After sulfuring, the trays are taken to open ground, and the fruit is cured in the sun. Only a very small fraction of the California product of evaporated apricots is cured in an evaporator. It requires about six pounds of fresh apricots to make one pound of cured fruit.



284. Good apricot fruits, one-half natural size.

A moderate estimate of the yield of apricots might be placed at seven and one-half tons to the acre; extreme yields are far away from this both ways.

The apricot is, as a rule, a very healthy tree in California. It is, however, subject to injury by scale insects of the lecanium group in some parts of the state. During recent years there has been increasing injury by a shot-hole fungus, which perforates the leaves and makes ugly pustules upon the fruit. Such fruit is unfit for canning except the fruit be peeled, which is little done as yet. It also makes low-grade dried product. This fungus can be repressed by fungicides of the copper class.

EDWARD J. WICKSON.

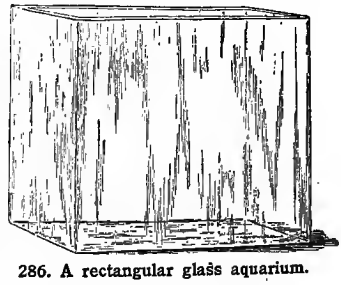
AQUARIUM. The aquarium as here understood is a glass tank for live fish, plants, and the like, for the dwelling-house or other suitable place.

The aquarium should be in a place where it may receive light, but direct sunlight is not necessary; and to keep an aquarium in a healthy condition, living plants in the water are absolutely necessary and plants will not thrive in dark rooms; neither will fish retain their bright coloring. The square or rectangular aquarium with open top affords a large breathing-space or air for the fish—which is another requisite, and the fish will be healthier and live longer than in a glass globe with small neck and orifice. Another and very important factor in the aquarium is sand and small pebbles. These should be washed clean of all soil before placing in the aquarium. About 2 inches over the bottom is sufficient. The plants should be planted before filling the aquarium with water. Figs. 285–287 show useful window aquaria.

An aquarium, to be in a healthy condition, should contain living plants—oxygenators—which are as necessary as food, as fish must have good air. The aquarium must be kept clean. The sediment should be removed from the bottom with a dip tube twice a week, and the inner side of the glass cleaned with a wiper once a week. Encourage the growth of the plants at all seasons; admit plenty of light, but no direct sunshine. There should also be a few tadpoles and snails in the aquarium. These are very essential, as they are scavengers, and devour the confervoid growth that frequently accumulates on the plants. In fall, give a thorough cleaning and rearrangement of the aquarium, so that all are in the best condition possible before winter sets in. In March it should be carefully looked over, and undesirable plants removed or transplanted. Additions may be made or any change if necessary.

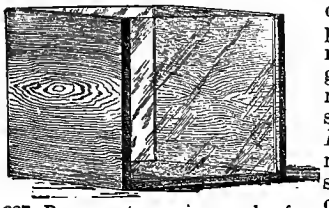
285. A museum-jar aquarium.

Following are some of the best plants to place in the aquarium, all of which can be easily and cheaply procured from dealers who make a specialty of aquatics: *Cabomba caroliniana* (commonly called Washington-grass or fish-grass) is one of the very best oxygenators and a most desirable plant for the aquarium and can usually be had in quantity at any season, except late in winter. It is usually sold in bunches, but after winter sets in, bunches of cabomba will not remain long in a healthy condition in the aquarium without care and attention. Plants to be of benefit in the aquarium must be living, and before these bunches of grass can emit roots and be self-sustaining, the fish too often nibble and disturb them to such a degree that, instead of being serviceable to the aquarium, they are a positive injury. *Elodea*, or *Anacharis* (water pest): there are two forms of this useful plant. *E. canadensis* is a very rapid grower and may be found in ponds in dense masses. When once established, it is a pest and hard to eradicate; but being of stem growth, it is not so readily grown in the aquarium. The giant form is a very desirable and valuable plant and can be used to good advantage, making a very interesting as well as a valuable plant in the aquarium. *Myriophyllum spicatum* somewhat resembles the cabomba, but is of a darker color and stronger in growth and texture. It is a hardy plant and will withstand the winters in the neighborhood of Philadelphia. When cabomba is unattainable, this may be had in good condition. It is also an excellent plant to use for fish spawn during the breeding season. This must not be confused with the *Myriophyllum proserpinacoides*, commonly called parrot's feather, as the latter is useless as an aquarium plant. *Sagittaria natans* is a very pretty strap-leaf variety of sagittaria and useful for a small aquarium. But *S. sinensis*, the giant form, is the best of all sagittarias for the aquarium, and is indispensable. When planted in the aquarium and allowed to get well rooted before the fish are introduced, it can be relied upon to maintain the aquarium



286. A rectangular glass aquarium.

in a healthy condition for several months. *Vallisneria spiralis* (eel-grass, tape-grass, wild celery) is a native plant inhabiting streams and rivers, and often used in the aquarium. Its long, narrow, strap-like blades or leaves are more flexible than the sagittaria and the tips float on the surface of the water. They are light green in color and of softer texture. It is a difficult plant to carry over winter, its natural propensity being to die down in winter, just the season when it is wanted in evidence in the aquarium. *Ludvigia Mulerttii* is one of the most conspicuous, ornamental and useful plants for the aquarium and is always in great demand. It is much larger and a stronger grower than *L. palustris* of the middle and northern states. It is a native of the southern states, whence come our supplies in winter in small quantities and for high prices, the plants very unsatisfactory at best. The difficulty is that plants, or rather sprays, plucked from growing plants and shipped North, receive a violent check in the change of temperature and the closely confined condition of the packing-case. The result often is that the plants or sprays lose a great part of their foliage, and when afterward subjected to cold running water are completely ruined. The only safe way is to secure stock during the summer or early fall, getting plants established in pots before preparing the aquarium for winter. In this condition, the plants will hold their own and winter over; but to attempt to grow southern stock in winter in our northern states is futile. There are a few other submerged plants that might be used, but the above-mentioned are the best and the best oxygenators for large or small aquariums. Floating plants should be used sparingly in the aquarium, an open, clean surface being most desirable and even necessary for air. Moreover, the majority of the floating plants are suitable only for summer culture. Another reason why surface or floating plants do not succeed in a house aquarium is that the water is deficient of plant-food suitable for such plants. Plants that die in an aquarium would, if transferred to a tub containing a quantity of soil, as well as water, make rapid and healthy growth. *Limnocharis Humboldtii* (water poppy) is a plant often used in the aquarium. It is necessary to plant this in the sand in the same manner as other aquatic plants, although the leaves are floating, similar to the leaves of a pond-lily. *Eichhornia crassipes major* (water hyacinth) is a very desirable plant for catching the fish spawn, but under ordinary conditions lasts but a few days in the aquarium. Miniature plants of these are very pretty, and fish are very fond of nibbling at the roots to the detriment of the plants. These, with many other plants, are best adapted for the summer aquaria where they can enjoy the benefit of sunlight and open air.



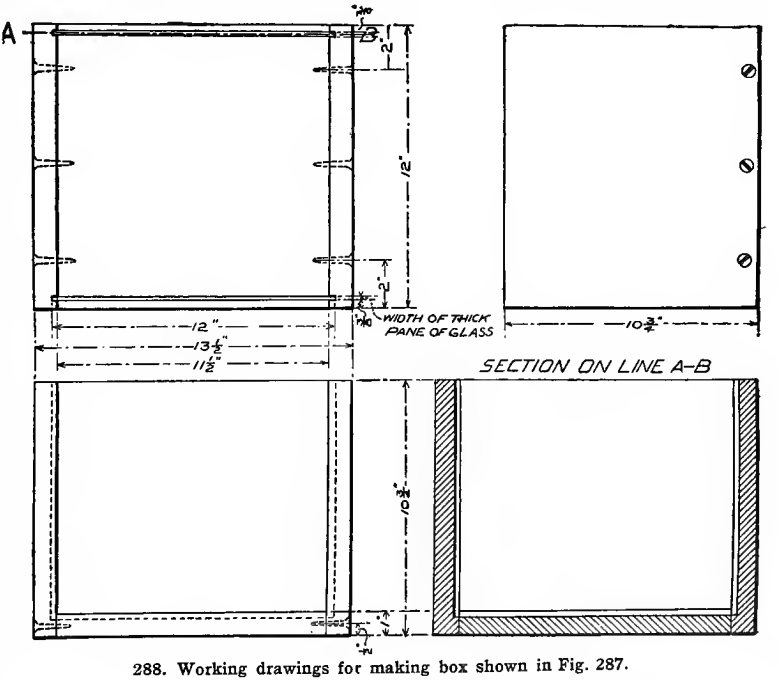
287. Permanent aquarium made of wood and glass.

Numerous free-floating plants are adapted to the aquarium, but too many must not be in evidence, or the fish may become suffocated. The azollas are very pretty, and the fish will occasionally eat the plants. The salvinia is another small plant often seen in the aquarium, but under favorable conditions it grows very rapidly, and forms a complete mat, which must be avoided. The European and American frog's-bits (*Limnobium Spongia, Hydrocharis Morsus-ranæ*) are very attractive plants, their long, silky roots reaching down in the water.

In summer the plants and fish should be placed out-of-doors in a fountain basin, pool, or a tub sunken in the ground in a partially shaded place; and a fresh aquarium should be stocked in the fall.

Aquariums are rapidly increasing in popularity for home use, and are of great service in nature-study. A permanent aquarium need not be an expensive affair. The rectangular ones are best if large fishes are to be kept, but they are not essential. A simple home-made aquarium of glass and wood (Fig. 287) is described in Jackman's "Nature Study," as follows (the dimensions being slightly altered): "Use an inch board 11½ inches wide and 12 inches long for the bottom, and two boards of the same thickness and length, 10¾ inches high, for the ends. Three-eighths of an inch from the edge on either side, with a saw, make a groove ¼inch deep and wide enough to receive loosely double-strength glass. Groove the end boards and fasten them to the bottom with screws, so that the grooves will exactly match. Partially fill the grooves with soft putty, or, better, aquarium cement, and press into each side a pane of glass. By making the bottom board 11½ inches long, an ordinary 10 x 12 window pane will be the proper size. When the glass is pressed to the bottom of the groove, draw the two ends in at the top until the glass is held firmly and then fasten them in place by narrow strips of wood, one on each side of the tank, placed on top of the glass and screwed to the end pieces. These strips also protect the hands from injury while working with the specimens in the aquarium. Before filling with water, the inner surface of the bottom and ends should be well rubbed with oil or paraffin and the grooves inside the glass well packed with putty." After the box is made it would be well to let it stand in water for a day or two. The wooden sides will swell and tighten the joints, and leakage will be less probable.

WILLIAM TRICKER.

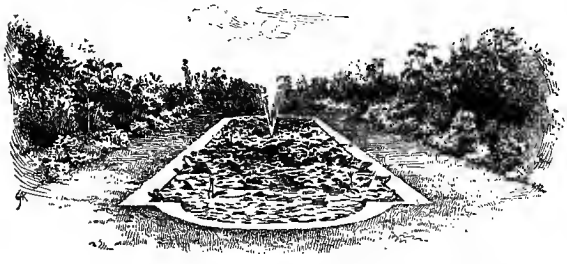


288. Working drawings for making box shown in Fig. 287.

AQUATICS

AQUATICS. A term applied to plants suited to cultivation only in water, particularly to those grown in ponds and tanks.

North America is the most highly favored country in the world for the cultivation of aquatic plants. Collections can easily be made to furnish a display of flowers from April to October in the open without artificial heat. There are numerous aquatic plants other than nympheas, nelumbiums and victorias. Some very desirable plants are *Acorus japonica variegata* (variegated sweet flag), *Aponogeton distachyus* (Cape pond-



289. Lawn pond of aquatics, with mason-work margin.

weed, or water hawthorn), *Caltha palustris* and *C. palustris fl. pl.* (marsh marigolds), *Cyperus Papyrus* (Egyptian paper plant), limnanthemums in variety. Some of the bog or marsh plants may be used in margins, as many varieties of sagittaria, not omitting the common cat-tail, *Typha latifolia*, the hibiscus of mammoth proportion, and the beautiful new hybrids with gorgeous flowers of all shades from pink to scarlet and crimson. See *Bog-gardening*. Figs. 289 and 290 show formal and informal lawn ponds.

Soil.—All aquatics require a rich soil, and this without limit, a depth of water from 1 to 3 feet, and ample space to spread their succulent leaves. In a natural pond, in which there is an accumulation of humus overlaying a clayey subsoil, nothing more is wanted, but on a sandy or gravelly bottom it is necessary to place a layer of rich earth 12 to 18 inches deep. In artificial ponds, built of masonry (Fig. 289), a layer of rich soil is necessary if the things are to be planted out, as is best for nelumbiums. The soil best suited for aquatics is a turfy loam, inclining to heavy, and thoroughly rotted cow-manure, two parts of the former to one of the latter, and, when possible, it should be composted some time before using, and turned over two or three times to thoroughly incorporate the manure. When cow-manure can not be obtained, other thoroughly rotted manure may be used. The next best fertilizer is pulverized sheep-manure, but this, being less bulky and stronger in proportion, should not be used so freely as other manures; one part sheep-manure to nine of soil is sufficient. Chemical manures, ground bone, horn shavings, and the like should not be used unless in extreme cases, and then very cautiously. Tankage may be used to good advantage. It contains dried blood, and ground bone. It is very desirable for permanent beds or soils that may continue two or more seasons without renewing. The bone is not readily dissolved and has a lasting quality. Blood, being soluble, has immediate effect and is a valuable fertilizer, if used sparingly.

Depth of water.—In natural ponds, water-lilies are found growing in water from a few inches to 4 and 6 feet deep, but in artificial ponds a depth of 12 to 18 inches will be found sufficient for most nympheas, and 18 to 24 inches is a good depth for victorias. In constructing an artificial pond, a depth of 2 to 2½ feet is ample. Water to the depth of 12 inches above the crowns of the plants is sufficient, and a box containing the soil may be 12 inches deep. Thus a pond 2 feet in depth is deep enough, and will allow a man, with hip boots on, to walk between the plants with ease. For a small pond, less than 12 feet over, a plank laid across will suffice for all operations.

Protection.—Where severe frosts are prevalent in winter, and ice 12 to 18 inches in thickness is found, there will be danger of the roots freezing. In such cases, an additional depth of 6 inches will be a great advantage, and a protection of bracken, salt hay, green manure, leaves, or any other non-conducting materials should be used to protect the masonry, in severe weather, against expansion and breakage. To protect tubs, small pools or ponds, cover with boards and pile on dry leaves to the depth of 8 or 12 inches, then salt hay or fresh stable-manure to keep the leaves from blowing away. This is one of the best means of protection against freezing. The general use of concrete work instead of brick and stone is to be commended. Reinforcement makes the walls frost-proof and water-proof.

Planting.—All hardy nympheas may be planted any time between the 1st of April and the 1st of September. Those planted early, other things being equal, will give good results the same season, while those planted late will get well established before winter, and will be in excellent condition to start at nature's summons early the following spring. The hardy nympheas differ considerably as to rootstocks. Those of the native species are long and of a spongy, soft texture, and rambling in growth, while the European species have a much larger and very firm rootstock, and grow more compact. In planting, all that is necessary is to press the rootstock firmly into the soil, and if there is any danger of the root rising to the surface, place a brick or any weight upon it, to keep it in position until anchored by its own roots. Tender nympheas should not be planted until the latter end of May or beginning of June, according to location. They should not be planted out before coleus, alternanthera, and other tender bedding plants. They require to be started indoors, and will be grown in pots, which are much handier to plant than roots of the hardy varieties, and can be planted under the water with ease and facility. Nelumbiums should not be planted until about the 1st of May. Southward the season is earlier. The existing conditions should be such that tubers shall start at once into active growth.

290. A lawn pond.

They should be already "started" before setting out. The tubers should be laid horizontally in a slightly excavated trench and covered with 2 or 3 inches of soil, using a weight, if necessary, to keep the tubers in position. Plants established in pots or pans are very convenient for planting, and may be purchased when tubers can no longer be procured, and can be planted a month later in the season with good results.

The *Victoria regia* has always been an aristocrat among water-lilies, and few cultivators could indulge in such a horticultural luxury. To grow it satisfactorily, a large surface space with a greater depth of water is necessary than for other aquatics, and a higher temperature is needed at the early stages. It can be cultivated in the open air, but artificial heat must usually be applied and protection afforded, so as to maintain a temperature of 85° F. In 1898 the introducer of *V. Trickeri* brought the Victoria within easy reach and culture of all lovers of aquatic plants. *V. Trickeri* is entirely distinct from other known varieties and can be grown in the open alongside of *Nymphæa zanzibariensis* and *N. devoniensis*, and under precisely the same conditions. When planted out about the middle of June, the plants grow rapidly, and will develop their gigantic leafage and magnificent flowers in August, and continue to do so until destroyed by frost. *V. Trickeri* is none other than *V. Cruziana*, which was never introduced into cultivation until 1898. All that existed outside of its native haunts, on the Parana River, South America, was an herbarium specimen of part of a leaf. It is now generally and extensively grown throughout the United States and in Europe where aquatics are cultivated.

Enemies.—Aquatics, like other plants, have their enemies in the way of insect pests, although in a less degree than most plants. Aphides are sometimes troublesome, or at least very unsightly. These, however, have their enemies, especially the coccinella (lady-bird), insectivorous birds, and so on. When these do not keep them down, a weak application of kerosene emulsion will make a clearance. Another method of getting rid of these pests, especially in a small artificial pond, where an overflow is (or should be) provided, is to take the hose with a spray, using a little force, and drive the insects off the plants, and, as they readily float on the water, the action with the hose will drive them out at the overflow pipe. Recently an insect pest that has its home in Florida has migrated northward, causing some annoyance. The larva of the moth *Hydrocampa proprialis* eats the leaf, and also cuts out pieces of the same, which it uses for protection, thereby greatly disfiguring the plant, and at the same time making it difficult to get at the enemy. The best remedy for this and the nelumbium moth, which is very much like it, is a lamp trap. Any ordinary lamp placed near the plants at night, and standing in a shallow vessel containing kerosene, will attract the insects, which, on striking the lamp, fall into the kerosene and are no further trouble. For other insects, such as leaf-miners and those which eat the leaves of plants, the best remedy is arsenate of lead. Muskrats are more or less troublesome, especially where nelumbiums are grown. They will eat the tubers in winter and early spring, and will make sad havoc with banks. They will also eat the roots of some nymphæas. The best remedy for these is the steel trap. A sporodic disease has also made its appearance. The leaves are affected with spots, which, under a damp, warm atmosphere, spread rapidly. Such climatic conditions, followed by bright sunshine, cause the affected leaves to shrivel up. This greatly weakens and checks the plants. This disease yields readily to a weak solution of bordeaux mixture. The same remedy is also very valuable in ridding the pond of all confervoid growth.

Tub culture should be resorted to only from lack of space, or when no other method can be adopted (Fig. 291). For this system of culture, nymphæas should be chosen that are moderate growers, yet free-flowering, and other miscellaneous aquatic plants. The tubs should hold from 4 to 12 cubic feet of soil for nymphæas, according to the variety, some being moderate growers, others vigorous and robust. The tubs may remain above ground or sunken. If sunken during the warm weather, the roots are kept cooler, and this is desirable, especially if hardy kinds are grown. A great improvement over tubs is a concrete pool 4 or 5 feet in diameter made in the shape of a tub, and 2 feet deep. A circular form 4 or more feet in diameter should be made and the ground then excavated 8 inches larger than the form. This will allow a wall of concrete 4 inches thick. Wire netting should be used for reënforcing, arranged so as to be in the middle of the wall. Use a mixture of sand,

291. Tub of water-lilies.

gravel or cinders in the following proportion: two bags of Portland cement, three wheelbarrows of sand, five wheelbarrows of gravel or finely broken stone or cinders and limoide equal to one-fourth of cement. This must be thoroughly mixed before using. After the second day, remove the form and lay the bottom with the same material 4 to 6 inches thick. This will make a strong, durable, water-tight pool and at a very moderate cost.

WILLIAM TRICKER.

[The standard book on the American culture of aquatics is "The Water Garden," by Wm. Tricker, N. Y., 1897, pp. 120, to which the reader is referred for extensive cultural directions and for lists of aquatic plants. For botanical descriptions of the various kinds of aquatics, with brief, special cultural directions, the reader may consult the articles in this Cyclopedia, under the various genera, as *Nelumbium*, *Nymphæa*, and *Victoria*.—L. H. B.]

AQUILÈGIA (from *aquilegus*, water-drawer, not from *aquila*, eagle). *Ranunculàceæ*. COLUMBINE. Hardy perennial herbs of the northern hemisphere; grown for their profusion of showy flowers in early summer, and the delicate foliage later on in the year. See page 3565.

Mostly with paniculate branches, terminated by showy fls., and 1–3 ternately-compound lvs., commonly glaucous: the lfts. roundish and obtusely lobed: fls. large, showy, usually in spring or early summer; sepals 5, regular, petaloid; petals concave, produced backward between the sepals, forming a hollow spur; stamens numerous: fr. of about 5 many-seeded follicles.—About 30 distinct species. J. G. Baker, A Synopsis of the Aquilegia, in G.C. II. 10:19, 76, 111, 203 (1878).

The columbines are among the most beautiful and popular of all hardy plants. The tall and strong-growing

species can be used to advantage in half-shady positions. The attractive forms and rich variations in hue of aquilegias come out well when associated with hemerocallis, Siberian irises, thalictrums, polygonatums, *Spiræa Filipendula* and wild ferns. In the North, a similar effect is produced by grouping columbines together with white and blue *Lupinus polyphyllus*, *Campanula persicifolia*, *Iris germanica* and *I. pallida* var. *dalmatica*, Iceland poppies and trollius. For rockeries, the low-growing early alpine species, such as *A. alpina*, *A. Stuartii* and *A. flabellata* are well adapted. Throughout the middle and northern states, columbines need winter protection, dry leaves being preferable for covering.

Seeds sown in pans, in coldframes in March, or open air in April, occasionally bloom the first season, but generally the second. The different species should be some distance apart, if possible, if pure seed is desired, as the most diverse species hybridize directly. They may be propagated by division of the roots in late fall, winter or early spring, but the better way is by seeds. Absolutely pure seed is hard to obtain except from the plants in the wild state; and some of the mixed forms are quite inferior to the true species from which they have come. *A. cærulea*, *A. glandulosa*, and *A. vulgaris* are likely to flower only two or three years, and should be treated as biennials; but *A. vulgaris* may be kept active for a longer period by transplanting.

A light sandy soil, moist, with good drainage, sheltered, but exposed to sun, is what aquilegias prefer. Some of the stronger species, when of nearly full flowering size, may be transplanted into heavier garden soil, even heavy clay, and made to succeed; but for the rearing of young seedlings, a light, sandy loam is essential. The seed of most columbines is rather slow in germinating, and it is necessary to keep the soil moist on top of the ground until the young plants are up. A coldframe, with medium heavy cotton covering, is a good place to grow the plants. The cotton retains sufficient moisture to keep the soil moist on top, and still admits sufficient circulation of air to prevent damping-off of the young seedlings. When large enough, the seedlings may be pricked out into another frame for a time, or, by shading for a few days until they get a start, they may be set into the permanent border, or wherever they are to be placed. (F. H. Horsford.)

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A. *Sepals not more than ½ or ¾in. long: expanded fls. 1 or 1½ in. diam.*

B. *Limb of petal shorter than the sepal.*

1. **Jònesii,** Parry. True st. very short or almost wanting, soft-pubescent: tufted root-lvs. 1–2 in. high from the stout, ascending branches of the rootstock, biternately divided; partial-petioles very short or none; lfts. very crowded: fls. blue; sepals oblong-obtuse, equaling the spurs, and twice the length of the petal-limbs and head of stamens: follicles glabrous, large, nearly 1 in. long; styles half as long; peduncles lengthening to about 3 in. in fr. July. Wyoming and Montana. G.F. 9:365.

2. **oxysèpala,** Traut. & Mey. Plant 2½ ft., slightly pubescent above: radical lvs. long-petioled, secondary divisions sessile: sepals blue, ovate-lanceolate, much exceeding in length the petal-limbs, which are 6 lines long, white, rounded-truncate; stamens not protruding beyond the petal-limb; spur knobbed, bent inward, shorter than petal-limb: follicles pubescent, with styles their own length. June. Siberia.—Said to be one of the first to bloom, and one of the most attractive in the list. It is one of the most dwarfed; fls. large blue, yellow and white; it comes so much before the others that its pistils, as a rule, all fertilize before any of the other species come into flower." Only recently intro. to cult.

3. **lactiflòra,** Kar. & Kir. St. 1½ ft. high, glabrous in the lower part: partial-petioles of root-lvs. 1½–2 in. long; lfts. sessile or short-stalked, 1 in. long, many lobes reaching half way down; st.-lvs. petioled and compound: fls. about 3 to a st.; sepals nearly white or tinged with blue, over ½in. long, narrow; petal-limb half as long as sepal; spur ½in., slender, nearly straight, not knobbed at tip; stamens equal in length to the limb. June. Altai Mts., Siberia.—A desirable species, but not much planted.

292 Aquilegia canadensis.

BB. *Limb of petal about equal to sepal.*

4. **viridiflòra,** Pallas. St. 1–1½ ft. high, finely pubescent throughout, several-fld.: the partial-petioles of root-lvs. 1–2 in. long; lfts. sessile or the end one shortly stalked, lobes rather narrow and deep; lower st.-lvs. petioled, biternate: sepals oblong, obtuse, ascending, greenish, equaling the broad, greenish petal-limb, but not reaching the head of stamens; spur straight, slender, ½in. long, not knobbed: pubescent follicles as short as their styles. Summer. E. Siberia.—Not so much used as the following variety:

Var. **atropurpùrea,** Vilm. (*A. atropurpùrea*, Willd.). Limbs of the petals deep blue or lilac-purple, and the sepals and spur somewhat tinged with the same hue. B.R. 922.

5. **canadénsis,** Linn. Common Columbine of Amer. Figs. 292, 293. Height 1–2 ft.: primary divisions of petioles of root-lvs. 1–2 in., having 3 divisions; 2 or 3 of the st.-lvs. petioled, biternate: fls. several to a st.; sepals yellowish or tinted on the back with red, about ½in. long, not reflexing; limb of petals a little shorter, yellowish, truncate; spur ¾in. long, nearly straight, knobbed at the end, bright red throughout; stamens much protruding: follicles ¾in. long, with styles half as long. May–July. Stony banks, east of Rocky Mountains. Introduced 1890. B.M. 246. L.B.C. 9: 888. Mn. 5:21. R.H. 1896, p. 109. F.W. 1878:33.—There are some beautiful hybrids of this and the blue

species. Var. **nàna,** Hort. Plant 1 ft. high or less: fls. like the type.

Var. **flavéscens,** Hook. A pale-lvd. yellow-fld. variety. Very pretty. Intro. 1889. This has often been called *A. flavescens,* Wats.; *A. cærulea* var. *flavescens,* Lawson; *A. flaviflora,* Tenney; *A. canadensis* var. *flaviflora,* Brit. B.M. 6552 B.

293. Radical leaves of Aquilegia canadensis.

6. **Buergeriàna,** Sieb. & Zucc. (*A. atropurpùrea,* Miq.). More slender than *A. vulgaris;* 1 ft. high, finely pubescent toward the top; branched to form several heads, bearing 2–3-petioled, biternate lvs.; partial-petioles of basal lvs. ½–1 in. long, with 3 sessile divisions: fls. yellow, tinted with purple, 1–1½ in. diam.; sepals ¾in. long, acute, spreading; spurs erect, nearly straight, as long as the limb of petals, and about equaling the sepal; head of stamens equal to limb in length: follicles pubescent, ¾in. long, style half as long. Early. Japan.—Brought from St. Petersburg, 1892.

AA. *Sepals about 1 in. long: expanded fl. about 2 in. diam.*

B. *Spurs shorter than the petal-limb, and incurved.*

7. **flabellàta,** Sieb. & Zucc. St. 1–1½ ft., few-fld.: partial-petioles of root-lvs. 1 in. or more, lfts. nearly sessile; st.-lvs. large and petioled: fls. bright lilac, or pale purple or white; sepals 1 in. long, obtuse; limb of petal half as long, often white in the lilac-fld. form; spur shorter than the limb, slender toward the end, much incurved; stamens not protruding beyond the petal-limbs: follicles glabrous. Summer. Japan. R.H. 1896, p. 109. Var. **nàna-álba,** Hort. (var. *flòre-álba,* Hort.). Fls. pure white: plant dwarfish. R.B. 15:157. B.M. 8354 (var. *nivea*).

BB. *Spurs at least as long as petal-limb.*

C. *Stamens short, not much protruding.*

8. **leptocèras,** Fisch. & Mey. St. several-fld., about 1 ft. high: partial-petioles of root-lvs. over 1 in., lfts. sessile; st.-lvs. petioled biternate: fls. violet, with the tips of the sepals greenish, and tips of the short petal-limb yellow; spur slender, slightly curved, ½in. long, not knobbed; stamens protruding a little beyond the limbs of petals: follicles slender, glabrous, nearly 1 in. long. Summer. E. Siberia. B.R. 33:64. F.S. 3:296.—Little used in Amer.

9. **vulgàris,** Linn. (*A. stellàta,* Hort. *A. atràta,* Koch). Common Columbine of Eu. Sts. 1½–2 ft. high, many-fld., finely pubescent throughout: root-lvs. with 3 partial-petioles 1½–2 in. long, secondary branches certain, ultimate lf.-lobes shallow and roundish, texture firm; lower st.-lvs. petioled and biternate: fls. violet, furnished with a claw, acute, 1 in. long, half as wide; petal-limb ¾in. long, equaling the head of stamens; spur about same length, stout, much incurved, knobbed: follicles densely pubescent, 1 in. long, style half as long. Summer. Eu., Siberia, and naturalized in Amer. Gn. 12, p. 288; 70, p. 16 (as *A. stellata*). G.W. 3, p. 229. Var. **flòre-plèno,** Hort. Fls. much doubled, ranging from pure white to deep blue. Here belong many horticultural varieties with personal names. Var. **Vervæneàna,** Hort. (var. *fòliis-aùreis,* Hort. Var. *atroviolàcea,* Hort.). Lvs. with yellow variegated lines.

Var. **nívea,** Baumg. (var. *álba,* Hort.). Munstead's White Columbine. Often 2–3 ft. high: a great profusion of large, pure white fls. for several weeks in early spring. Var. **nívea grandiflòra,** Hort., is much like this.

Var. **olýmpica,** Baker (*A. olýmpica,* Boiss. *A. Wittmanniàna,* Hort. *A. blánda,* Lem.). A fine variety, with several large fls.; sepals light lilac or bright purple, 1 in. or more in length; petal-limb white. I.H. 4:146. R.H. 1896, p. 108.

Var. **hýbrida,** Sims. Much like the last variety, but with stout, lilac-purple spurs as long as the sepals, only slightly incurved.—Probably a hybrid of *A. vulgaris* and *A. canadensis.* B.M. 1221.

10. **sibírica,** Lam. (*A. bícolor,* Ehrh. *A. Garnieriàna,* Sweet. *A. speciòsa,* DC.). St. 1½–2 ft. high, many-fld.; often nearly glabrous throughout: partial-petioles of root-lvs. 1–2 in., sometimes showing 3 distinct branches; terminal lfts. 1 in. or more broad, lobes rather shallow and rounded; lower st.-lvs. petioled and biternate: fls. pale or bright lilac-blue; oblong sepals fully 1 in. long, spreading or reflexed a little; petal-limb half as long, equaling the head of stamens, and often white; spur rather stout, ½in. or more, very much incurved, or even coiled: follicles glabrous, 1 in. long, style ⅓in. Summer. E. Siberia. S.B.F.G. II. 1:90. Var. **flòre-plèno,** Hort. (*A. bícolor* var. *flòre-plèno,* Hort.). Fls. much doubled by the multiplication of both the limbs and the spurs.

Var. **spectábilis,** Baker (*A. spectábilis,* Lem.). A large, bright lilac-fld. var.; petal-limbs tipped yellow. Amurland. I.H. 11:403.

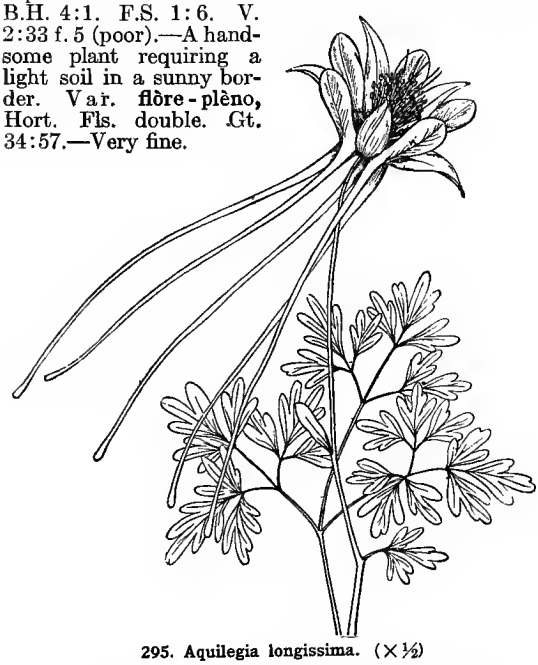
CC. *Stamens long, protruding far beyond the petal-limb.*

11. **formòsa,** Tesch. (*A. canadénsis* var. *formòsa,* Wats.). Habit as in *A. canadensis:* root-lvs. and st.-lvs. like that species, but fls. brick-red and yellow, or wholly yellow, and sepals larger, quite twice as long as petal-limb; spurs more spreading, somewhat more slender, and often shorter. May–Aug. Sitka to Calif., and east to the Rockies. Intro. 1881. B.M. 6552. F.S. 8:795. Gt. 32:372. R.H. 1896, p. 108. G.C. 1854:836. Var. **hýbrida,** Hort. (*A. califórnica* var. *hýbrida,* Hort. *A. supérba,* Hort.). Fls. large, with scarlet sepals and yellow petals; spurs spreading, long and slender. —A supposed hybrid with *A. chrysantha.* F.M. 1877:278. V. 2:33 f. 2. Var. **rùbra-plèno,** Hort. (var. *flòre-plèno,* Hort.). Fls. as in var. *hybrida,* but several whorls of petal-limbs. Var. **nàna-álba,** Hort. Fls. pale, often nearly white: plant not exceeding 1 ft.

Var. **truncàta,** Baker (*A. truncàta,* Fisch. *A. califórnica,* Lindl.). Fls. with short, thick spurs and very small sepals and a small petal-limb. Intro. 1881. F.S. 12: 1188 (as *A. eximia,* Hort.).

294. Aquilegia chrysantha. (×⅛)

12. **Skínneri,** Hook. St. 1–2 ft. high, many-fld., glabrous: root-lvs. long-petioled, with both primary and secondary divisions long; lfts. cordate, 3-parted; several st.-lvs. petioled and biternate: sepals green, keeled, lanceolate, acute, never much spreading, ¾–1 in. long; petal-limb greenish orange, half as long as sepal; spur bright red, tapering rapidly, over 1 in. long; stamens protruding far beyond the limb; styles 3: fr., at least when young, bearing broad, membranous, curled wings. After flowering, the peduncles become erect. July–Sept. Mts. of New Mex. B.M. 3919. P.M. 10:199. B.H. 4:1. F.S. 1:6. V. 2:33 f. 5 (poor).—A handsome plant requiring a light soil in a sunny border. Var. **flòre-plèno,** Hort. Fls. double. Gt. 34:57.—Very fine.



295. Aquilegia longissima. (×½)

BBB. *Spurs very long, several times the length of petal-limb.*

13. **chrysántha,** Gray (*A. leptocèras* var. *chrysántha,* Hook.). Fig. 294. Height 3–4 ft.: root-lvs. with twice 3-branched petioles, lfts. biternate; st.-lvs. several, petioled: fls. many on the plant, 2–3 in. across; sepals pale yellow, tinted claret, spreading horizontally; petal-limb deep yellow, shorter than the sepals, and nearly as long as the head of stamens; spur rather straight, very slender, divergent, about 2 in. long, descending when fl. is mature: follicles glabrous, 1 in. long; style half as long. May–Aug. New Mex. and Ariz. Gn. 16: 264; 51, p. 385. B.M. 6073. R.H. 1896, p. 108. F.R. 2:169. Gt. 33:84. G.C. 1873:1501. F.M. 1873:88. V. 2:33 f. 3. F.S. 20:2108. H.F. 4:120. H.U. 3, p. 324. Var. **flavéscens,** Hort. (*A. aùrea,* Junk. *A. canadénsis* var. *aùrea,* Roezl). Fls. yellow, tinged with red; spurs incurved, and shorter than in the type. Gt. 21:734. Var. **álba-plèna,** Hort. (var. *grandiflòra álba,* Hort.). Fls. very pale yellow or nearly white, with two or more whorls of petal-limbs. Intro. 1889. V. 12:311. G.W. 8, p. 375. Var. **nàna,** Hort. (*A. leptocèras* var. *lùtea,* Hort.). Like the type, but plant always small, not exceeding 1½ ft. Var. **Jæschkanii,** Hort. About the same height as last: fls. large, yellow, with red spurs.—Thought to be a hybrid of *A. chrysantha* × *Skinneri,* hence sometimes called *A. Skinneri* var. *hybrida,* Hort.

14. **longíssima,** Gray. Fig. 295. Tall, somewhat pubescent with silky hairs, or smoothish: root-lvs. biternate, even in the petioles; lfts. deeply lobed and cut, green above, glaucous beneath; st.-lvs. similar, petioled: fls. pale yellow, sepals lanceolate, broadly spreading, 1 in. or more, the spatulate petals a little shorter, about equaling the head of stamens; spur with a narrow orifice, 4 in. long or more, always hanging. Distinguished from *A. chrysantha* by its longer spur with contracted orifice, by the narrow petals, and by the late season of flowering. Late July to Oct. 1. Ravines S. W. Texas into Mex. G.F. 1:31 (adapted in Fig. 295).—The seed must be obtained from wild plants, as those cult. usually fail to produce seed; hence not much used.

AAA. *Sepals 1¼–1½ or even 2 in. long: expanded fls. 2½–3 in. diam.; stamens not protruding.*

B. *Spurs long and not incurved.*

15. **cærùlea,** James (*A. leptocèras,* Nutt. *A. macrántha,* Hook & Arn.). St. 1–1½ ft., finely pubescent above, bearing several fls.: lower st.-lvs. large and biternate; basal-lvs. with long 3-branched petioles; lfts. 3-lobed on secondary stalks: fls. 2 in. across, whitish, but variously tinted with light blue and yellow; sepals often blue, oblong, obtuse, twice as long as the petal-limb; spurs long, slender, knobbed at the end, rather straight, but curving outward; head of stamens equaling the petals: follicles pubescent, 1 in. long; style ⅓in. Apr.–July. Lower mt. regions, Mont. to New Mex. B.M. 4407; 5477. Gn. 16:264. Mn. 6:61. V. 2:33 f. 4. F.S. 5:531. F.R. 10:165. Gn. 59, p. 147. G. 28:241. Var. **álba,** Hort. Fls. of same size but entirely white. Intro. 1883. Var. **hýbrida,** Hort. Sepals some shade of blue or pink, or mixed, and petals nearly white or yellow, also called var. **lùtea,** Hort. The true form of this is probably *A. cærulea* × *A. chrysantha.* Gn. 51, p. 385. R.H. 1896: 108. A.G. 15: 315. I.H. 43: 61. Var. **Hélenæ,** Hort., is very probably a form of this hybrid; very robust, fls. numerous, blue and pure white. G.W. 6:212. Var. **flòre-plèno,** Hort. Fls. longer and very showy, more or less doubled toward the center.

BB. *Spurs incurved and hardly longer than petal-limbs.*

16. **alpìna,** Linn. (incl. var. *supérba,* Hort.). Fig. 296. St. nearly 1 ft. high, finely pubescent upwards, 2–5-fld., bearing petioled, biternate lvs.: partial-petioles of basal-lvs. 1–2 in. long, with 3 nearly sessile divisions, deeply lobed: expanded fl. 1½–2 in. across, blue, rarely pale or white; sepals 1¼ in. long, half as broad, acute; petal-limb half as long as sepals, often white; spur stout, incurved, same length as the limb; head of stamens not protruding: follicles pubescent, 1 in. long; style much shorter. May, June. Switzerland. L.B.C. 7:657. Gn. 9:384. F.W. 1879:353. B.M. 8303. Var. **álba,** Hort. Fls. pure white.

296. Aquilegia alpina. (×¼)

17. **glandulòsa,** Fisch. Fig. 297. St. 1–1½ ft. high, glandular pubescent in the upper half, 1–3-fld.: partial-petioles of root-lvs. 1–2 in. long, each with 3 distinct divisions; lft.-segms. narrow and deep; st.-lvs. few, bract-like: fls. large, nodding; sepals bright lilac-blue, ovate, acute, about 1½ in. long and half as broad; petal-limb same color, but tipped and bordered with creamy white, less than half the length of the sepals, very broad; spur very short, ¼–½in., stout, much incurved; stamens

not protruding: follicles 1 in. long, 6–10 in number, densely hairy, with short, falcate style. Allied to *A. alpina*, but a taller plant, with shorter spurs, larger fls., and a greater number of follicles. May, June. Altai Mts. of Siberia. B. 5:219. F.W. 1871:353. Gn. 15:278; 45, p. 193; 64, p. 26. Gt. 289 f. 1.—One of the handsomest.

297. Aquilegia glandulosa. (×¼)

Var. **jucúnda**, Fisch. & Lall. Fls. rather smaller than in the type; petal-limb white, more truncate at the tip; stamens as long as limb. B.R. 33:19. F.S. 5:535.—A fine variety, with some tendency to double.

18. **Stùartii**, Hort. A recorded hybrid of *A. glandulosa* × *A. vulgaris* var. *olympica*. Fls. very large and beautiful. It very much resembles the latter in form of sepals and petals, and the former in shape of spurs and coloration. May, June. Intro. 1891. Gn. 34: 344; 61, p. 409. G.M. 54:416.

19. **caryophylloìdes** is a garden name given to some very mixed forms, with a great variety of colors. Special characters seem not to be well fixed.

A. baikalénsis, Hort. Fls. large, violet-blue, spurs long.—*A. haylodgénsis*, Hort., and its var. *delicatíssima*, Hort., are much like *A. chrysantha*, and resemble it in habit and color of fls. but the spurs are not so long.

K. C. Davis.

ÁRABIS (*Arabia*). *Crucíferæ*. Rock-Cress. Small perennial or annual herbs, with white or purple flowers, grown mostly on borders and in rockwork.

Flowers mostly in terminal spikes or racemes, small, but often many or appearing for a considerable period of time: lvs. mostly undivided: siliques long, linear, flat: stigma 2-lobed.—In temperate regions, about 100 species, several native to this country; some of them are alpine. Usually prop. by division; also by seeds and cuttings. Hardy, requiring plenty of sun, and thriving even in poor soil. The following four species are perennials:

A. *Fls. purple or rose.*

muràlis, Bertol. (*A. ròsea*, DC.). A foot high, with a rather dense raceme of pretty fls.: lvs. oblong, sessile (the radical ones with a long narrow base), prominently and distantly blunt-toothed, sparsely pubescent. Spring and summer. Italy. B.M. 3246.

AA. *Fls. white.*

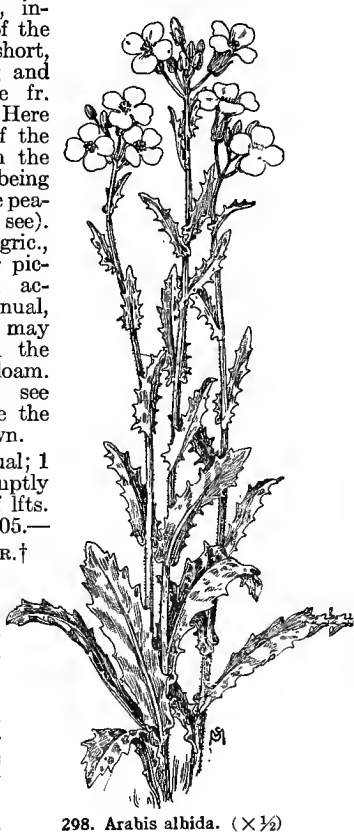
serpyllifòlia, Vill. (*A. nivàlis*, Guss.). Tufted, 2–6 in.: radical lvs. entire or few-toothed, the st.-lvs. small and sessile, not clasping: fls. in a short cluster, the calyx as long as the peduncle, the limb of the petals linear-oblong and erect. Eu.

álbida, Stev. (*A. caucásica*, Willd.). Fig. 298. A few inches high, pubescent: lower lvs. narrow at the base, the upper auriculate-clasping, all angle-toothed near the top: fls. in a loose raceme, the calyx shorter than the pedicel, the petal-limb oval and obtuse. Eu. B.M. 2046. Gn. 62, p. 280; 72, p. 67; 74, p. 620. F.E. 16:611. —Blooms early, is fragrant, and is well adapted for rock-gardens and edgings, and covering steep banks. Var. **flòre-plèno**, Hort. Double. Gn. 65, p. 306. Var. **variegàta**, Hort., has yellow-white stripes on lvs. Gt. 45, p. 108. Var. **Billardièri**, Boiss. (*A. Billardièri*, DC.). Hoary-pubescent, slender: lvs. small, very obtuse, entire or with 1 or 2 teeth at base: pod long, slender and spreading: fls. often tinged. Eastern. Gn. 63, p. 422.

alpìna, Linn. Fls. smaller than in the last, plant only slightly pubescent and hairy: lvs. somewhat clasping but not auriculate; small-toothed nearly or quite the entire length, the cauline ones pointed. Eu. B.M. 226. G.C. III. 30:239.—Blooms very early, and is one of the best rock-plants. Var. **variegàta**, Hort. Var. **nàna compácta**, Hort., a dwarf form. Gt. 44, p. 203. Var. **flòre-plèno**, Hort. Fls. full-double; handsome. Gt. 51, p. 211. G. 26:199.

A. arenòsa, Scop. Fls. rose varying to white: lvs. pinnatifid, those on the st. deep-toothed. Eu.—*A. aubrictioides* Boiss. Much like A. albida, but pale pink. Cilicia.—*A. blepharophýlla*, Hook. & Arn. Fls. large, rose-purple: lvs. sharp-toothed, sessile or clasping, the margins hairy. Calif. B.M 6087.—*A. Ferdinándii-Cobúrgii*, Kell. & Suenderm. Lvs. gray in rosettes, becoming green in winter: fls. small, yellowish. Macedonia.—*A. lùcida*, Linn. f. Fls. white: lvs. shining, obovate, clasping. There is a variegated form. Eu.—*A. móllis*, Stev. Fls. white: lvs. pubescent, large-toothed, the lower ones rounded and long-stalked. Eu.—*A. petræa*, Lam. Fls. white: lvs. toothed, the radical ones often parted, the st.-lvs. oblong-linear. Eu.—*A. præcox*, Waldst. & Kit.=A procurrens.—*A. procúrrens*, Waldst. & Kit. Fls. white: lvs. ciliate, those on the st. entire and sessile, the others stalked: stoloniferous. A variegated var. Eu.—*A. Stùrii*, Hort. A compact but vigorous garden form with large clear white fls.—*A. vérna*, R. Br. Annual, hairy: fls. large, purple: lvs. oblong-ovate to round-oblong, the upper ones clasping, rather coarse-toothed. Eu. B.M. 3331. L. H. B.

ÁRACHIS (Greek, *without a rachis*). *Leguminòsæ*. Peanut. Goober. The peanut is sometimes grown in the economic house of botanical gardens, and also as a curiosity in outdoor gardens. The genus has nine species, of which eight are Brazilian. Lvs. abruptly pinnate: fls. 1–3, yellow, in a dense, axillary, sessile spike; ovary stipitate, inclosed within the tube of the calyx, the stipe at first short, subsequently elongating and carrying the immature fr. beneath the ground. Here develops what is one of the most anomalous frs. in the whole Leguminosæ, it being wholly indehiscent,—the peanut of commerce (which see). See also Cyclo. Amer. Agric., Vol. II, pp. 514–519 for pictures and agricultural account. As a hothouse annual, the seeds of the peanut may be sown in heat, and the plants potted in sandy loam. For outdoor culture, see *Peanut*, by which name the plant is commonly known.



298. Arabis albida. (×½)

hypogæa, Linn. Annual; 1 ft. or less high: lvs. abruptly pinnate, with 2 pairs of lfts. and no tendril. Mn. 7:105.—Procumbent. N. Taylor.†

ARACHNÁNTHE. (Greek for *spider-flower*). *Orchidàceæ*. Included under *Renanthera*.

ARÀLIA (derivation obscure). *Araliàceæ*. Ornamental herbs, shrubs or trees grown chiefly for their bold foliage.

Stems often spiny: lvs.

alternate, deciduous, pinnate to 3-pinnate: fls. small, whitish, in umbels usually forming panicles; pedicels articulate; calyx-lobes minute; petals imbricate in bud; stamens 5; ovary 5-, rarely 2-celled, with the styles free or connate only at the base: fr. a berry-like drupe with 2–5 compressed stones.—About 20 species in N. Amer., Asia, Malay Archipelago and Austral.

The aralias are large herbs, shrubs or small trees, often spiny, with large decompound foliage, small whitish flowers in umbels forming large terminal panicles and followed by small usually black berry-like fruits.

The species are hardy or nearly hardy North. They prefer rich or heavy soil. They are often planted as single specimens on the lawn for the bold subtropical effect of their foliage. Propagation is by seeds sown in spring, which do best with slight bottom-heat, or by root-cuttings, also with bottom-heat.

There are also a number of tender shrubby plants cultivated as ornamental greenhouse or stove plants, which have been provisionally referred to the genus Aralia, as their flowers and fruits are not yet known; therefore it has not been possible to determine their true botanical affinity. In the present work they are referred to other genera. They should be looked for under *Polyscias*, *Pseudopanax*, *Schefflera*, *Oreopanax*, *Panax*, *Sciadophyllum*, *Dizygotheca*. Other related genera, perhaps not including any horticulturally important forms, are Heptapleurum and Monopanax.

A. *Prickly shrubs or rarely low trees: lvs. bipinnate, 2–3 ft. long: umbels numerous, in a large, broad, compound panicle: styles distinct.*

spinòsa, Linn. ANGELICA TREE. HERCULES' CLUB. DEVIL'S WALKING-STICK. Sts. very prickly, 40 ft. high: lvs. 1½–2½ ft. long, usually prickly above; lfts. ovate, serrate, 2–3½ in. long, glaucous and nearly glabrous beneath, mostly distinctly petioled; veins curving upward before the margin. Aug. Southern states north to Tenn. S.S. 5:211. Gn. 50, p. 126.—The stout, armed sts., the large lvs., and the enormous clusters of fls. give this species a very distinct subtropical appearance. Not quite hardy N. Bark possesses medicinal properties.

299. Aralia chinensis.

chinénsis, Linn. (*A. japónica*, Hort. *A. mandshùrica*, Hort. *Dimorphánthus elàtus*, Miq. *A. spinòsa* var. *canéscens*, Franch. & Savat.). CHINESE ANGELICA TREE. Fig. 299. Sts. less prickly, 40 ft.: lvs. 2–4 ft. long, usually without prickles; lfts. ovate or broad ovate, coarsely serrate or dentate, usually pubescent beneath, nearly sessile, 3½–6 in. long; veins dividing before reaching the margin and ending in the points of the teeth. Aug., Sept. China, Japan. M.D.G. 1897:461. Gn. 1, p. 561. G.W. 5:509.—In general appearance very much like the former species, but considerably hardier. Grows well also in somewhat dry, rocky or clayey soil. Var. **glabréscens,** Schneid. (*A. spinòsa* var. *glabréscens*, Franch. & Savat. *A. spinòsa* var. *canéscens*, Sarg. *A. canéscens*, Sieb. & Zucc.). Lvs. often prickly above; lfts. glabrous beneath, except on the veins, dark green above. More tender. Var. **mandshùrica,** Rehd. (*Dimorphánthus mandshùricus*, Maxim.). St. prickly: lfts. pubescent only on the veins beneath, more sharply and densely serrate than the foregoing variety and hardier. G.C. II. 10:592; 23:313. Var. **variegàta,** Rehd. (*A. japónica variegàta*, G.C.). Lfts. bordered with white. I.H. 33:609. G.C. III. 31:231. Gn. 63, p. 379. Var. **aùreo-variegàta,** Rehd. (*Dimorphánthus mandschùricus elegantìssimus fol. var.*, Hort.). Lfts. variegated with yellow.

AA. *Unarmed herbs: styles united at the base.*

B. *Umbels numerous, in elongated puberulous panicles: 3–10 ft. high.*

racemòsa, Linn. SPIKENARD. Height 3–6 ft.: glabrous, or slightly pubescent: lvs. quinately or ternately decompound; lfts. cordate, roundish ovate, doubly and sharply serrate, acuminate, usually glabrous beneath, 2–6 in. long: fls. greenish white. July, Aug. E. N. Amer. west to Minn. and Mo. B.B.2:506.—Root-stock employed medicinally; properties similar to those of sarsaparilla.

califórnica, Wats. Height 8–10 ft.: resembles the preceding: lfts. cordate, ovate or oblong-ovate, shortly acuminate, simply or doubly serrate: panicle loose; umbels fewer, larger, and with more numerous rays. Calif. M.D.G. 24:343.

cordàta, Thunb. (*A. edùlis*, Sieb. & Zucc.). Height 4–8 ft.: lvs. ternately or quinately decompound, pinnæ sometimes with 7 lfts.; lfts. cordate or rounded at the base, ovate or oblong-ovate, abruptly acuminate, unequally serrate, pubescent on the veins beneath, 4–8 in. long. Japan. Gt. 13:432 (as *A. racemosa* var. *sachalinensis*). R.H. 1896, p. 55. A.G. 13, pp. 6, 7. Young stalks edible: see *Udo*.

cachemírica, Decne. (*A. cashmeriàna*, Hort. *A. macrophýlla*, Lindl.). Height 5–8 ft.: lvs. quinately compound, pinnæ often with 5–9 lfts.; lfts. usually rounded at the base, oblong-ovate, doubly serrate, glabrous or bristly on the veins beneath, 4–8 in. long. Himalayas.

BB. *Umbels several or few on slender peduncles; pedicels glabrous: 1–3 ft. high.*

hìspida, Vent. BRISTLY SARSAPARILLA. WILD ELDER. Height 1–3 ft., usually with short, woody st., bristly: lvs. bipinnate; lfts. ovate or oval, rounded or narrowed at the base, acute, sharply and irregularly serrate, 1–3 in. long: umbels 3 or more in a loose corymb; fls. white. June, July. From Newfoundland to N. C., west to Minn. and Ind. B.M. 1085. L.B.C. 14:1306.—Bark diurectic, alterative.

nudicaùlis, Linn. WILD SARSAPARILLA. SMALL SPIKENARD. Stemless or nearly so: usually 1 lf., 1 ft.

high, with 3 quinately pinnate divisions; lfts. oval or ovate, rounded or narrowed at the base, acuminate, finely serrate, 2–5 in. long: umbels 2 or 3; fls. greenish. May, June. Newfoundland to N. C., west to Mo. B.B. 2:506.—Rootstock employed medicinally; properties similar to those of sarsaparilla.

A. japónica, Thunb.=Fatsia japonica.—*A. papyrífera*, Hook.=Tetrapanax papyriferum.—*A. pentaphýlla*, Thunb.=Acanthopanax pentaphyllum.—*A. quinquefólia*, Decne. & Planch.=Panax quinquefolium.—*A. Sieböldii*, Hort.=Fatsia japonica.—*A. trifólia*, Decne. & Planch.=Panax trifolium. (See also *Ginseng.*)

ALFRED REHDER.

ARATICÚ: *Annona* and *Rollinia.*

ARAUCÁRIA (Chilean name). Including *Columbea* and *Eutacta*. *Pinàceæ*. Large South American and Pacific Australian evergreen trees (about a dozen species), grown in their juvenile state in greenhouses and windows and often used in summer for lawn decoration; they are very decorative pot-plants.

Tall strict or widely branching conical trees: lvs. small, scale-like and stiff, clothing all the branches uniformly and usually closely imbricated: fls. mostly dicœcious, the staminate terminal and solitary or disposed in fascicles; anthers 6–8-celled; pistillate fls. in ovoid or globose heads that become large woody cones with only 1 seed underneath each scale.—The South American species (Columbea) have scarcely winged cone-scales, the cotyledons 2, and the germination hypogeal (cotyledons remaining below ground); the Australian and Pacific species (Eutassa) have winged scales, cotyledons 4, and germination epigeal.

Araucarias are probably the most prized pot evergreens in cultivation. They are much used in house decoration, particularly at Christmas time, as they are not only attractive but will stand much hard usage. *A. excelsa* (Fig. 300) is the one commonly seen in residences. Propagation is by seeds and cuttings, as given under *A. excelsa* below. Symmetrical plants are secured from the leading shoots. Side shoots are likely to make misshapen specimens, as seen in Fig. 301. The araucarias need cool treatment. The temperature should not be above 60° at night. If kept too crowded or not given sufficient light, they become ragged and straggling, as in Fig. 302. In summer the plants should be protected from direct burning sun.

300. A good specimen of Araucaria excelsa.

The species thrive in the open in southern Florida and in parts of California. *A. imbricata* is the hardiest. It is rarely seen in greenhouses. *A. Bidwillii* is apparently the second hardiest, and also one of the best species for all purposes. *A. excelsa* and its allies are about as hardy in southern Florida as crotons and acalyphas.

The commonest species in greenhouses is *A. excelsa*. It is grown on an enormous scale in many nurseries for decoration as window or table plants. When raised from seed the plants grow rapidly and the branches are invariably disposed in tiers with wide internodes, often as much as 2 feet separating each tier of branches. Such plants are of little use for ordinary decorative work and recourse is made to plants raised from cuttings. This practice has grown up as it is found that plants raised from cuttings assume a dwarf compact habit, with the tiers of branches placed close together, and that they do not grow into large specimens until many years old. The plants for stock purposes are usually raised from seed, and when they have formed some three to six tiers of branches the tops are taken out and put in as cuttings in light sandy compost in a close house or case at a temperature of about 60° F. They are kept shaded from hot sun and damped over frequently until rooted. The stock plants are kept growing and soon break out into new growth in the axils of each of the upper branches. These are all "leader" growths, and when long enough they each furnish a suitable cutting which is treated in the same way as the primary growth or leader. After each of these has been removed for stock, the stem of the stock plant is cut off to the next tier of branches, which in turn will furnish another set of cuttings and so on until the plant is reduced to the bottom layer of branches, when it is discarded and another stock obtained again from seed. It should be pointed out that the branches themselves may be rooted as cuttings, but they always retain their flat asymetrical shape and are useless for stock purposes. (See Fig. 301.)

301. Unsymmetrical Araucaria excelsa, grown from a side shoot.

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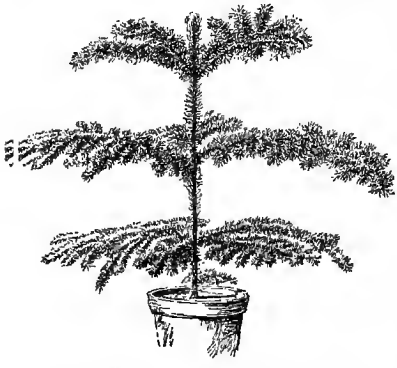
A. *Lvs. (or most of them) awl-like, at least at apex.*

1. **excélsa**, R. Br. NORFOLK ISLAND PINE. Figs. 300–303. Plant light green: branches frondose, the lvs. curved and sharp-pointed, rather soft, ⅓–½in. long, and densely placed on the horizontal or drooping branchlets. Norfolk Isl. F.R. 2:411.—The commonest species in this country, being much grown as small pot specimens. A blue-green form is cult. as var. **glaûca**, (or *A. glaùca*). It is a form in which the tips of the growths are white when young; has recently been intro. under the name of "Silver Star." It is a most beautiful plant and sure to have a great future as a market plant. There is also a strong-growing, large variety, with very deep green foliage, var. **robústa**, Hort. Var. **virgàta**, Hort., primary branches with no secondary branches, or very short ones. In its native wilds *A. excelsa* reaches a height of over 200 ft. and a diam. of even 9 or 10 ft. The solid, globular cones are 4 or 5 in. diam.

F.S. 22: 2304–2305.—An excellent house plant, and keeps well in a cool room near a window. In summer it may be used on the veranda, but must be shaded.



302. Araucaria excelsa, a poor specimen because too crowded or not sufficient light.

The timber is used for ship-building.

2. **Cúnninghamii,** Sweet. Plants less formal and symmetrical than *A. excelsa*, the upper branches ascending and the lower horizontal: lvs. stiff and very sharp-pointed, straight or nearly so. There is also a glaucous form (*A. glaùca*); also a weeping form. Austral., where it reaches a height of 200 ft., yielding valuable timber and resin. Locally known as hoop pine, Moreton Bay pine, colonial pine, coorong, cumburtu, coonam.

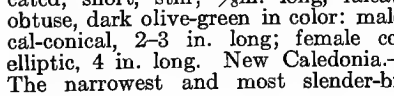
3. **Coókii,** R. Br. (*A. columnàris*, Hook.). A slender columnar tree, much narrower in shape than *A. excelsa* which it closely resembles when young: branches disposed as in *A. excelsa*, but tree tending to shed the lower ones; branchlets crowded on the branches and turning upwards in a boat-like form: young lvs. alternate and rather closely arranged on the branchlet and ¼in. long, broad and slightly decurrent at base, slightly curved, mucronate; adult lvs. densely imbricated, short and ovate, obtuse; cones 3–4 in. diam. and somewhat longer. New Caledonia, where it reaches a height of 200 ft., making very straight and imposing shafts. B.M. 4635. A.F. 12:559.—Named for Captain Cook. Var. **aùrea,** Hort., has golden-yellow foliage. There is also a var. **glaùca,** Hort., with silvery lvs.

303. Araucaria excelsa. (×½)

4. **Balánsæ,** Brongn. & Gris. (*A. élegans*, Hort. Bull.). A dwarf-growing species of slow growth (when grown as a pot-plant) and with few loosely arranged tiers of branches, usually 5 in a tier; branchlets distichous, narrow and deflexed with age: lvs. imbricated, short, stiff; ⅛in. long, falcate, more or less obtuse, dark olive-green in color: male cones cylindrical-conical, 2–3 in. long; female cones globose or elliptic, 4 in. long. New Caledonia.—Rarely grown. The narrowest and most slender-branched species in cult.

AA. *Lvs. broader, usually plane and imbricated.*

5. **Rùlei,** Muell. Fig. 304. Leafy branchlets very long: lvs. oval-elliptic, imbricated, concave, arched towards the branch, nearly or quite obtuse, with a prominent dorsal nerve, silvery gray on the upper and rich glossy green on the lower side. Variable at different ages. When young, the branches are often drooping and the lvs. compressed and obscurely 4-angled and nearly or quite subulate, var. **polymórpha,** R.H. 1866, p. 350. There is also a var. **compácta.** New Caledonia. Reaching 50 ft. in height. R.H. 1866:390, and plate. I.H. 22:204. A strikingly beautiful plant and somewhat rare in cult. The figure in G.C. 1861:868, is *A. Mùelleri*, Brongn. & Gris., a broader-lvd. species. Var **Goldieàna,** Hort. (*A. Goldieàna*, T. Moore). A variety with narrower lvs. and with branches rather more erect than the type. F. 1877:39. A var. **élegans,** Hort., is described ,with smaller lvs., and close-whorled more slender branches: dwarf.



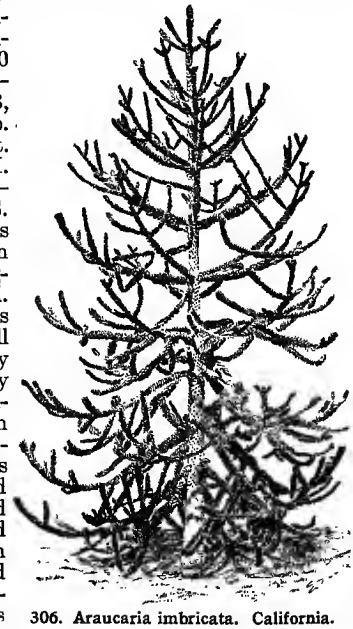
304. Araucaria Rulei. (×½)

6. **Bídwillii,** Hook. Fig. 305. Rather narrow in growth, especially with age, the branches simple: lvs. in two rows, lance-ovate and very sharp-pointed, thick, firm and shining. Austral., where it attains a height of 150 ft., and is known as bunya-bunya. R.H. 1897, p. 500, desc. G.C. III. 15:465, showing the pineapple-like cone.—One of the best and handsomest species for pots.

305. Araucaria Bidwillii. (×½)

7. **braziliàna,** A. Rich. (*A. grácilis*, Hort.). Branches verticillate, somewhat inclined, raised at the ends, tending to disappear below as the plant grows: lvs. alternate, oblong-lanceolate, 1–2 in. long, somewhat decurrent, much attenuated and very sharp-pointed, deep glaucous green, loosely imbricated: cone large and nearly globular. S. Brazil, reaching a height of 100 ft. F.S. 21:2202. Var. **élegans** (*A. élegans*, Hort.), is a form with very numerous branches and more crowded and often glaucous lvs. Var. **Ridolfiàna,** Gord., is a more robust form, with larger and longer lvs.

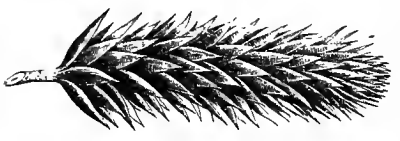
8. **imbricàta,** Pav. Monkey Puzzle. Figs. 306, 307. A striking tree of pyramidal habit: branches generally in 5's, at first horizontal, with upward-curving (sometimes downward-curving) tips, but finally becoming much deflexed; branchlets in opposite pairs, curved upward when young, and continuing to grow until several feet long when adult: lvs. imbricated and persisting, even on the trunk, ovate-lanceolate, very stiff, leathery, and sharp-pointed, 2 in. long on the primary st. and branches, 1 in. long on the branchlets, slightly concave at the base, bright green on both sides: cone 6–8 in. diam. Western slope of the Andes in Chile, reaching a height of 100 ft. F.S. 15: 1577–1580. R.H. 1893, p. 153; 1897, pp. 271, 319, desc. Gt. 44:115. G.C. III. 21:288; 24:154.—Hardy in the S. This is the species which is grown in the open in England and Ireland. The hardiest species in cult. Thrives well in a heavy loamy soil in a moist valley or position sheltered from rough winds in mild climates. The branches are heavy and rather brittle and the beauty and symmetry is soon destroyed if planted in an exposed position. The timber is



306. Araucaria imbricata. California.

valuable. The seeds constitute the chief food of the aborigines in some sections of S. Amer. Var. **platifòlia**, Hort., is a form with very broad lvs.

A. albospica, Hort.=A. excelsa.—*A. Dómbeyi*, A. Rich.=A. imbricata.—*A. intermèdia*, R. Br. Tall and erect, sparingly branched, nearly denuded of foliage: lvs. sessile, imbricated, cordiform, obtuse, green and shining. New Caledonia.—*A. Lindleyàna*, Van Houtte=A. braziliana.—*A. mantàna*, Brongn. & Gris. Tall: lvs. scale-like, curved, ovate, obtusish, more or less concave, with white spots in many series. New Caledonia.—*A. Müelleri*, Brongn. & Gris. Lvs. almost flat, with whitish spots in series. New Caledonia.—*A. Niepráschkii*, Baumann. Branches wide-spreading with long drooping side branches: perhaps a form of A. Rulei. R. B. 31: p. 132.—*A. subulàta*, Vieill. Like A. intermedia, but trunk less naked, and lvs. linear-subulate. New Caledonia.



307. Araucaria imbricata. ($\times \frac{1}{2}$)

L. H. B.
C. P. RAFFILL.

ARBORETUM.—A living collection of trees and other woody plants.

Collections of trees have found a place in the botanic gardens of all countries since the physic garden at Tokyo was founded eight hundred years ago; and for more than three centuries individuals have made such collections for the decoration of estates or for purposes of study. In Europe the largest collection of the woody plants of temperate regions is found in the Royal Gardens at Kew; and in the Dutch Colonial Garden at Buitenzorg on the island of Java is the most important collection of the trees of the tropics. Small experimental arboreta composed chiefly of timber trees of supposed value have been planted in conection with most of the forest schools or forest institutes of Europe.

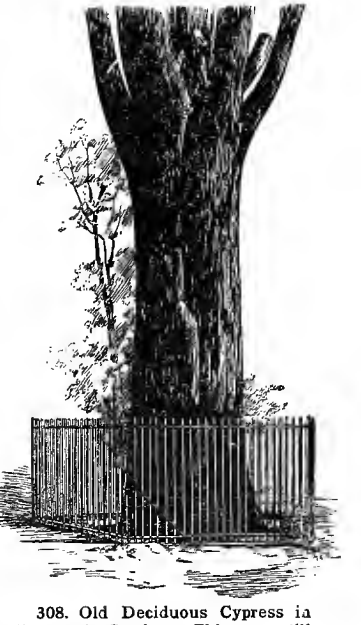
Historical sketch.

As early as the middle of the sixteenth century, a collection of trees was made at Touvoye in France by René du Bellay, Bishop of Mans, who received the seeds of a number of exotic trees from Pierre Belon, physician and traveler, who first brought to Europe some of the trees of western Asia. In its day, the garden at Touvoye was pronounced by the botanist Gesner the richest and most beautiful in France, Germany and Italy. Like most of the early collections of trees made by individuals, all traces of the trees planted by René du Bellay have disappeared.

Nearly two centuries later, the head of the French Marine, Duhamel du Monceau, a man of scientific attainments, wealth and social influence, gathered from Europe and North America large collections of trees on his two estates of de Veigny and du Monceau and formed what must be considered the first arboretum made with scientific purpose. Du Monceau undertook a critical study of his collections and published in 1755 his "Traité des arbres et arbustes qui se cultivent en France." His arboretum is said to have contained a thousand species of woody plants belonging to one hundred and ninety-one genera. Duhamel's publications and example had much influence and led to the introduction of many exotic trees into French parks and plantations. Noble specimens of the cedar of Lebanon, the deciduous cypress of the southern United States and other trees planted by him, are still living.

The arboretum established in 1825 in France at Les Barres near the village of Nogent-sur-Vernisson (Loiret) by Pierre Philippe André de Vilmorin is still one of the most important dendrological stations in Europe. Vilmorin was especially interested in the different geographical forms or varieties of the principal timber trees of Europe and made large plantations of these and of a number of exotic trees. In 1866, after the death of the founder, the arboretum at Les Barres was purchased by the French Government and now, greatly improved and enlarged by new plantations, is known as the Arboretum National des Barres and is used as a school of sylviculture. In 1906 a critical catalogue of this collection, prepared by Monsieur L. Pardé, Inspector des Forêts, and accompanied by an atlas of plans of the arboretum and pictures of many of its principal trees, was published in Paris. The value of the arboretum at Les Barres has been increased by the formation in its immediate neighborhood of the Fruticetum Vilmorinianum. This collection of shrubs, which is the most complete in Europe, was established in 1894 by the grandson of the founder of the arboretum at Les Barres, Monsieur Maurice L. de Vilmorin, who has been successful in introducing many interesting plants into gardens through his relations with French missionaries in China. A catalogue of the Fruticetum Vilmorinianum was published in 1894.

In 1857 Monsieur Alfonse Lavallée began to plant an arboretum at Segrez in the Department of Seine-et-Oise. This was a scientific enterprise and the value of the living collections was increased by the establishment at Segrez of a botanical library and herbarium. Aided by the professors of the Muséum d' Histoire Naturelle in Paris, it had become in 1875, when the "Enumération des Arbres et Arbrisseaux Cultivés à Segrez" was published, one of the largest collections of woody plants that had been made up to that time. This catalogue was followed in 1880 by the "Arboretum Segrezianum" in which appear critical descriptions and figures of some of the rare plants cultivated at Segrez. Six parts with thirty-six plates of this work appeared. M. Lavallée died suddenly in 1884 and his publications and a few trees in the park at Segrez are the only monuments left of his zeal and industry in the study of trees. In 1858 Monsieur G. Allard began the arboretum at la Maulévrie, near Angers in France, which he still maintains, and which contains one of the largest and most interesting collections of the oaks of Europe and southwestern Asia in the world, and is particularly rich in conifers.



308. Old Deciduous Cypress in Bartram's Garden. This tree still stands, although dead.

At Muskau in the valley of the Neisse in Silesia, on the estate made famous by the beauty of arrangement given to it by Heinrich Hermann von Puckler, an important arboretum was established by Prince Frederick of the Netherlands, who purchased the Muskau estate in 1845. The critical catalogue of the plants in the Muskau Arboretum by Petzold & Kirchner, published in 1864, and entitled "Arboretum Muscaviensis," is a standard work on cultivated trees and shrubs. Many of the trees planted by von Puckler are still living, but the arboretum is now conducted as a commercial nursery.

In Great Britain, no important scientifically managed collection of trees and shrubs, with the exception of those connected with general botanic gardens, has been attempted. The arboreta, however, connected with the

national gardens at Kew, Edinburgh and Dublin have greatly increased the knowledge of trees and stimulated the taste for planting not only in Great Britain but in all civilized countries. At Kew is to be found probably the largest number of species of trees and shrubs which has yet been gathered together, for in England more plants can be made to grow together than flourish in any one country on the continent of Europe or in any one place in the United States. Kew, as a garden in connection with royal residences has existed since the middle of the sixteenth century; in 1841 it was created a national garden and its growth and improvement have continued uninterruptedly ever since. In the older parts of the garden many noble trees testify to the age of the establishment, but it was not until 1848 that the systematic planting of an arboretum was begun by Sir William Hooker, the first director of the national garden. The reputation of the succeeding directors of Kew, its scientific standing and the interest of the nation in its garden have made it possible to gather there plants from all parts of the world; and although much of the soil occupied by the arboretum is not well suited for the growth of trees, and the smoke of the city makes the cultivation of conifers and many other evergreen plants difficult and sometimes impossible, every serious student of trees must avail himself of the great opportunities for study which this arboretum affords. A collection of trees was once planted by the Horticultural Society of London at its gardens in Chelsea; this was given up by the Society many years ago. On many of the large private estates in England, Scotland and Ireland there are important arboreta; and the desire of the owners of British estates to cultivate new trees, especially conifers, stimulated the botanical explorations in all the temperate parts of the world in the first half of the nineteenth century undertaken by the Horticultural Society of London and by some of the large firms of European nurserymen. Some of these private collections have been of great value to students.

In connection with the Quinta Normale and the Museum of Natural History in San Diego in Chile is a small but remarkable arboretum in which are found the oaks, hickories, magnolias and other trees of eastern North America flourishing as they flourish nowhere else outside the United States, and with these the poplars and birches of northern Europe are growing with the cypresses and pines of California, and the eucalypti of Australia.

Few interesting collections of trees have been made in North America. In 1728 John Bartram, a Pennsylvania farmer and later distinguished as a traveler and botanist, purchased a piece of land on the banks of the Schuylkill River about three miles from Philadelphia and established a botanic garden, in which he planted a number of American trees collected in his various journeys, which extended from the shores of Lake Ontario to Florida, or received from his correspondents in Europe; among these were some of the famous botanists of the day. Bartram was appointed botanist to the King of England and, through his labors, many American trees were introduced into England and many Old World plants first reached America. Bartram died in 1777. Later his garden was used as a nursery and, after having passed through the hands of various owners, was bought in 1891 by the city of Philadelphia and is now a public park. A few only of the trees planted by John Bartram are now standing. Fig. 308.

Bartram by his own labors and through his European correspondents attained much influence, and is one of the most interesting figures among those who have increased the knowledge of American trees. Not the least important of his good works was the inspiration which his cousin, Humphrey Marshall, another Pennsylvania farmer, derived from his example and advice. Marshall in 1773 made a garden and planted a number of trees near the Bradford Meeting-house now in the village of Marshalltown, a few miles from West Chester, traveled widely to study and collect plants, and in 1785 published the "Arbustum Americanum," a description of the trees and shrubs indigenous to the United States. This was the first book on plants written by a native-born American. Many of the trees planted by Marshall have grown to a great size and are still in a flourishing condition. His arboretum is now the most interesting of the old collections of American trees.

The garden and arboretum planted about 1830 by John Evans, another Pennsylvanian, in Delaware County about twelve miles west of Philadelphia, contained for many years one of the largest collections of plants in the United States. Evans kept up an active correspondence with Sir William Hooker, the Director of the Royal Gardens at Kew, from whom he received the seeds of many Himalayan and other rare and little-known plants. A few only of the trees planted by Evans, who died in 1862, are now alive; among them is probably the largest specimen of the European hop hornbeam in the United States.

In 1841 Henry Winthrop Sargent, of Boston, bought Wodenethe, an estate of twenty-two acres above Fishkill Landing, New York, overlooking the Hudson River. A friend and pupil of his neighbor, A. J. Downing, Sargent through Downing's influence became interested in the cultivation of trees and especially of conifers. At Wodenethe every coniferous plant that could be obtained was tested, and for forty years it remained the most important place in the United States for obtaining information on the value of these plants for cultivation in this country. If the results of Sargent's experiments were largely negative, that is if they were more successful in showing what trees were not suitable for the eastern states than in adding numerous species to the number of conifers which can be permanently grown here, they were of great interest and value to the country. For many years the influence of H. W. Sargent among lovers of country life in the United States was considerable and has done much in the last sixty years toward increasing the knowledge of trees and directing sound horticultural taste. To this influence is largely due the horticultural careers of his relatives, Horatio Hollis Hunnewell and Charles Sprague Sargent.

In 1852 Mr. Hunnewell began the development of an estate in the valley of the Charles River at Natick (now Wellesley), about twelve miles west of Boston. Here, with the aid of his relative at Wodenethe, he planted coniferous trees for which the well-drained gravelly soil proved to be suited. Past middle life when he began to plant his trees, he was able to see many of them attain a large size and his pinetum, in number of species and beauty of individuals, the most important in the United States. In the hands of a younger Hunnewell, it is constantly enlarged and improved, and Wellesley is still one of the most interesting places in America for the lover of cultivated trees.

About 1870 Josiah Hoopes, author of "The Book of Evergreens," the only American book on the subject, planted in connection with his nursery in West Chester, Pennsylvania, a large number of coniferous trees. This at the time was one of the best collections of these plants that had been made in the United States. Twenty-five years later, and after Mr. Hoopes' death, although a large number of the species had disappeared, many survived to show their beauty and value as ornamental trees. The Hoopes pinetum should be visited by everyone interested in the cultivation of conifers.

In 1874 Charles A. Dana, the distinguished journalist, bought Dosoris, an island about fifty acres in extent off the north shore of Long Island, near Glen Cove, and began planting trees. Great intelligence and industry was shown in this undertaking, and in the Dosoris collection are still found many rare trees and

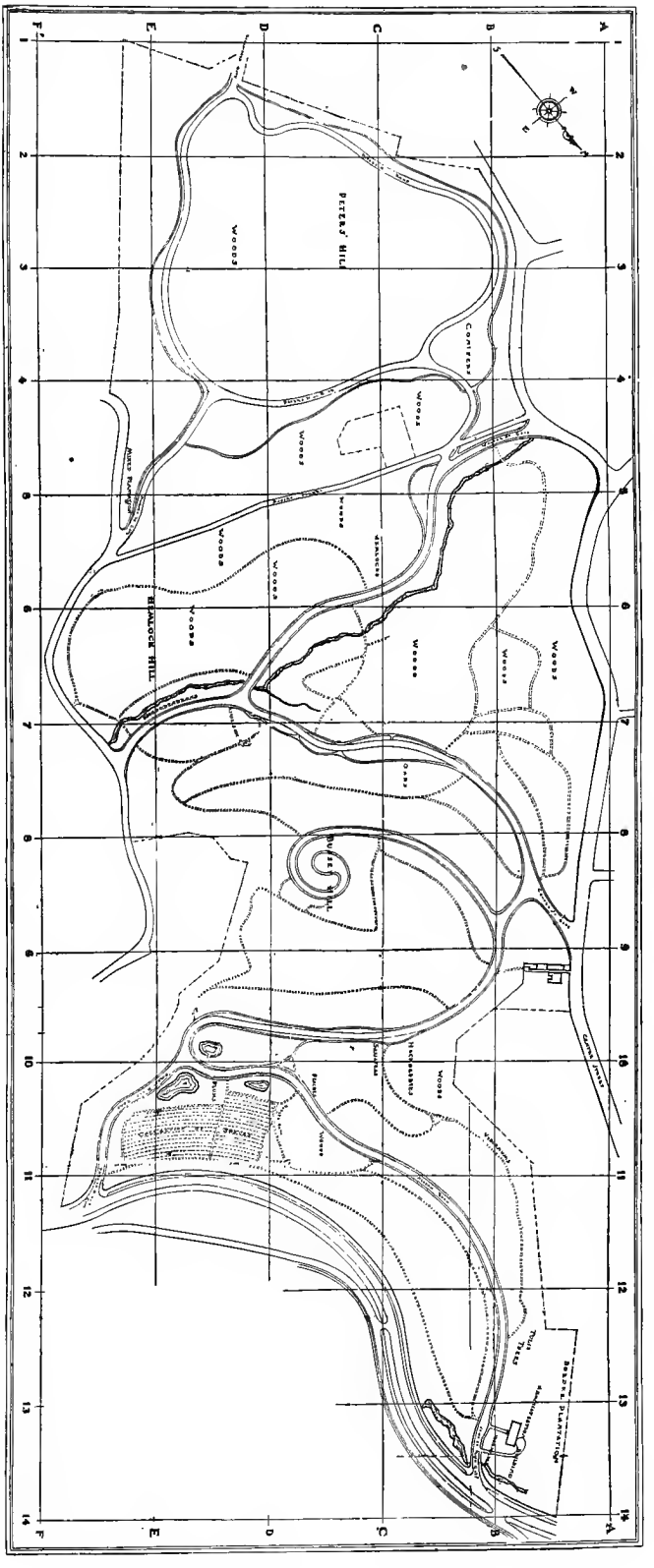
shrubs of exceptional size and beauty; but with the change of owners this, like most private collections of trees in the United States, is probably destined to suffer from neglect or to entirely disappear.

In Highland Park, Rochester, New York, on grounds admirably situated for the purpose, the park department of that city has established an arboretum which contains one of the largest collections of trees and shrubs in the United States and which, situated as it is in a great center of commercial horticulture, cannot fail to become a powerful factor in horticultural education. Equally important in educational possibilities is the excellent arboretum which has been established by the Government of the Dominion of Canada on its Central Experimental Farm at Ottawa. Placed in a region of great winter cold, the lessons which the Ottawa Arboretum can teach of the hardiness of plants will be of special value to Canada and to the northern borders of the United States.

The influence of American nurserymen by their introduction and multiplication of trees and shrubs must not be overlooked, and American lovers and students of trees will always gratefully remember such names as Kenrick and Hovey of Massachusetts, Price and Parsons of Long Island, Ellwanger and Barry of Rochester, New York, Thomas Meehan of Pennsylvania, Berckmans of Georgia, and Robert Douglas of Illinois. The arboreta which they planted in connection with their nurseries offered in their time valuable object lessons, and the influences of their publications are often of lasting value.

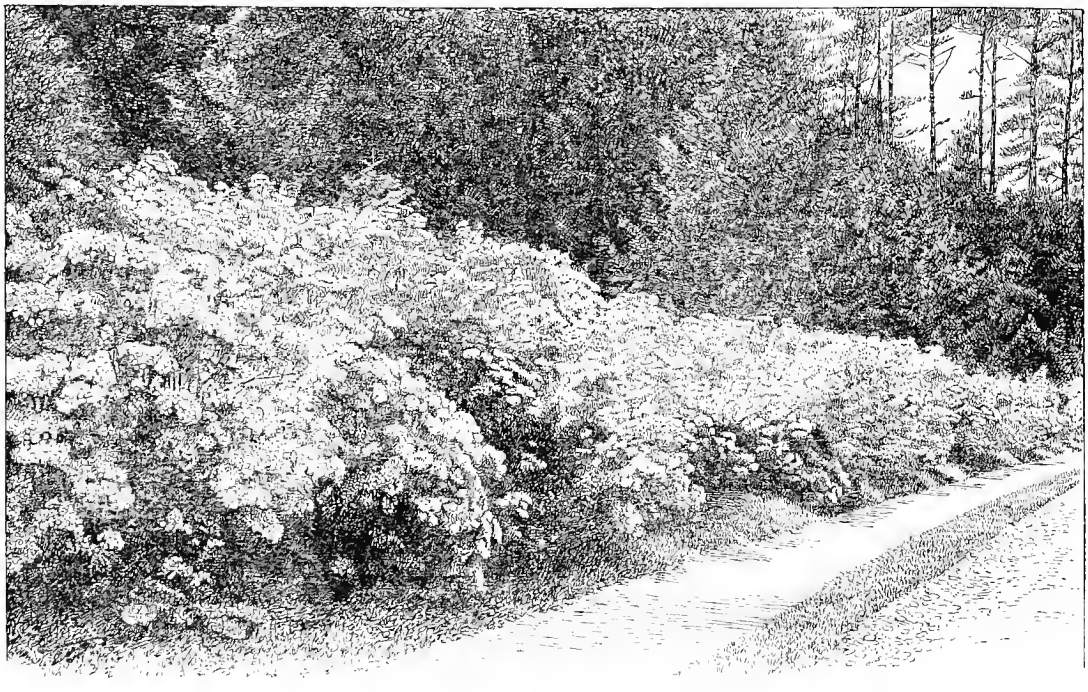
The Arnold Arboretum. Figs. 309–311.

It has been left to Harvard University to establish an arboretum on a large scale and in a manner which seems destined to make it permanent. This arboretum owes its origin to Mr. James Arnold, a merchant of New Bedford who died in 1868, leaving to the trustees of his estate $100,000 to be devoted to the advancement of agriculture or horticulture. One of these trustees was George B. Emerson, the author of "The Report on the Trees and Shrubs of Massachusetts." Mr. Emerson, realizing the benefit which the world might derive from the establishment of a scientifically managed collection of trees in the neighborhood of Boston, proposed to turn over Mr. Arnold's legacy to the President and Fellows of Harvard College to be used to develop and maintain an arboretum, provided they would devote to this purpose a part of the farm in West Roxbury which had been given to the university by Mr. Benjamin Bussey. This plan was carried out in 1872, and 125 acres were set aside for the Arnold Arboretum, in which the University undertook to grow a specimen of every tree and shrub able to support the climate of eastern Massachusetts. In December, 1882, a contract was made between the university and the city of Boston under which the city agreed to add certain adjoining lands to the arboretum, to construct and maintain under the direction of its park commission a system of carriage-drives and walks



309. Map of the Arnold Arboretum, Jamaica Plain, Mass., a Department of Harvard University.

planned under the direction of Frederick Law Olmsted, to police the grounds and to assume all taxes which might be levied on the property during the thousand years for which the contract was made. In return for this assistance, the university agreed to open the arboretum to the public from sunrise to sunset during every day of the year, reserving, however, entire control of all the collections and of the grounds with the exception of the drives and walks. Work on the roads was begun by the city in 1885, but through various delays in construction, the planting of the principal collections of trees and shrubs was not undertaken until the following year. In 1894, seventy-five acres, known as Peter's Hill, and a part of the Bussey farm, were added to the arboretum by the President and Fellows of the university, and in 1898 were opened to the public by an encircling road built by the park department of the city. This contract with the city of Boston is of great value to the arboretum, for, as it cannot be moved from its present location without the consent of the university and the city, there is little chance that, however valuable the land may become, the people of Boston will ever consent to give up a public park of unusual character and great beauty. The assumption of all taxes by the city during 1,000 years insured by this contract may become an important contribution to the arboretum.



310. Kalmia in bloom at the Arnold Arboretum.

The Arnold Arboretum occupies 220 acres of meadow, hill and valley. It forms one of the series of Boston parks with which it is connected by a broad parkway. It is close to the Forest Hills station of the New York, New Haven & Hartford Railroad, and it can be reached from all parts of the city by two lines of electric cars. Its natural features are a broad meadow along the northeastern boundary, and three high hills separated by narrow valleys through one of which flows a small stream. One of these hills is covered by a remarkable growth of hemlock trees, and natural woods, in which large individuals of many of the trees of eastern New England are found, cover other parts of the arboretum.

The purpose of the Arnold Arboretum, as this has been understood by its management, is to increase the knowledge of trees and other woody plants. To accomplish this, something more than the collection of living plants hardy in eastern Massachusetts contemplated by the trustees of James Arnold's will was necessary, and the Arnold Arboretum as now organized is, first, an out-of-door museum in which the public can see the trees and shrubs of the north temperate zone conveniently arranged; second, a dendrological station and laboratory in which the scientific study of trees is carried on, and third, a bureau of publication, exploration and exchange through which botanical exploration in different parts of the world is undertaken and the results and products of these explorations made known and distributed.

In the arrangement of the out-of-door museum—the living collection of trees and shrubs—the species to facilitate study have been arranged in groups of genera and families in a natural sequence whenever conditions of soil and situation have made this possible, a further attempt being made to arrange the planted groups in harmony with the native woods and the other natural features of the ground. All the groups of trees, shrubs, and all the natural woods are easily reached by grass paths which extend to all parts of the grounds. In the case of the trees of North America, several individuals of each species have been planted, but want of space has generally made it impossible to plant more than one individual of an Old World species. In the groups of American trees, one specimen is planted with abundant space for the full development of its branches and the others are arranged in a compact group to show their habit under such conditions.

For the convenience of students, the shrubs of genera in which there are no hardy trees, and all vines, have been arranged in a sequence of genera in long parallel beds near one of the principal entrances; but the shrubs belonging to genera in which some of the species are hardy trees have been planted in connection with the groups of trees of these genera. In addition to the shrubs in the general shrub collection, supplementary

collections of several of the large genera of shrubs have been established, usually in sheltered positions, in which are planted new or imperfectly known species or species that require unusual care or special protection.

The collections of the Arnold Arboretum are rich in the woody plants of eastern North America, northern Europe, Siberia, China and Japan, and contain the largest number of species and varieties of these plants to be found in any American collection; and gradually the Arboretum, with its hills and valleys, its native woods and varied vegetation, has developed into one of the most beautiful of all the public gardens of the world.

A large part of the trees and shrubs planted in the Arboretum has been raised in its nurseries from seeds collected in those parts of the region occupied by the species in which the climate most resembles that of New England. A record of the origin and history of all the plants is kept on the cards of a catalogue, and the position of every tree permanently planted in the groups is recorded on the sheets of a large scale map, and with this is kept the detailed history of each tree. Labels giving the Latin and English names and the region that they inhabit are placed at the height of the eye on the trunks of prominent native trees standing near drives and walks, and these labels are found on the trunks of many of the planted trees in the different groups. Metal labels with raised letters are used for the plants in the shrub collection and for shrubs and small trees near some of the walks. Wooden stakes giving their names are placed before many shrubs and small trees; and to every plant, whether otherwise labeled or not, a small zinc label is attached.

In order to make the Arnold Arboretum a scientific station and something more than a collection of living trees, an herbarium of woody plants intended eventually to represent the ligneous vegetation of the world and a library now containing 29,000 bound volumes and 6,000 pamphlets have been formed. An herbarium and library connected with such an institution are essential for the determination and correct labeling of the living collections and make possible original scientific work. A report on the forest wealth of the United States, the reports of state and national commissions appointed to study American forest conditions, the illustrated "Silva of North America," the "Manual of the Trees of North America," a "Forest Flora of Japan," "Trees and Shrubs," a monograph of the genus Lonicera, a monograph of the pines of Mexico, many of the articles on trees and shrubs in this Cyclopedia, the ten volumes of Garden and Forest, the Jesup collection of North American woods in the American Museum of Natural History in New York, are some of the contributions to knowledge which the arboretum as a scientific station has been able to make. For several years, it has been actively engaged in bibliographical studies, and the results of these studies are being published in the "Bradley Bibliography," of which two volumes have appeared. An elaboration of the woody plants of China is in progress, based largely on the collections of E. H. Wilson, one of the arboretum explorers, and is now being published by the arboretum in the "Plantæ Wilsonianæ."

In connection with its work in search of material for its collections, officers and employees of the arboretum have visited nearly every part of North America, have traveled in Peru and Chile, and explored the Caucasus, Japan, Korea, and northern and western China. Through these explorations, the Arnold Arboretum has been able to introduce into the gardens of the United States and Europe a large number of new plants or plants that have been long lost to cultivation, and through these introductions it has established relations in all countries with the principal botanic gardens, the important nurserymen and many individuals interested in trees and their cultivation.

The work the Arnold Arboretum attempts and the demands which are made on it are national in scope and extent, but for a national American arboretum a more temperate and equable climate than that of Massachusetts is desirable. Its situation, however, in the midst of a population famous for its generosity and actively interested in horticulture, and the stability it enjoys from its connection with a great university, and from its contact with the city of Boston, are favorable to it. It is impossible, however, to cultivate in one collection the trees which grow naturally or can be made to grow in all the different regions of the United States, and the American national arboretum of the future must first of all be an institution, like the Arnold Arboretum, of long life and continuous control; and this central institution properly equipped with laboratories and material for research must be in a position to establish branches in Florida, Arizona, California and in some central regions of the continent, for in such branches managed by the central institute, it would be possible to collect and to study nearly all the trees of the world suitable for different parts of the country, and so make possible in the United States an arboretum really national in character.

311. Trees still standing in the Humphrey Marshall collection.

Herbaria are chiefly valuable when they supplement collections of living plants; and it is now becoming gradually acknowledged that accurate knowledge of trees and of many other groups of plants can be obtained only by a comparative study of the plants themselves. The opportunity for this will be found only in establishments in which plants in large groups can be assembled and grown under conditions favorable for their best development. Today the palms of the tropics, especially those of the Old World, can be satisfactorily studied only in the great collection of these plants gathered together in the botanic garden at Buitenzorg in Java. Some groups of northern trees and shrubs can now best be observed in the Arnold Arboretum, but to obtain exact information of others the student must make long and sometimes difficult journeys. Until, for example, collections of the cactaceæ and of plants like the agaves and yuccas are assembled in a region favorable to their growth, like southern New Mexico or Arizona, it will be impossible to obtain a true understanding of these plants which, when grown in northern greenhouses or in regions unsuited to their peculiar needs, more often mislead than illuminate. Comprehensive collections of the species of eucalyptus, acacia and other Australasian plants established in California would be of great value to that state; and collections of tropical and subtropical plants in southern Florida would immensely benefit not only

the southern part of that state but all the West Indies and other tropical countries.

A nationalized arboretum.

The arboretum, therefore, worthy to be considered national in scope and accomplishment in a country of such varied climates as North America must consist of a number of stations in different parts of the country under one management and with one central head from which the work of the different stations should be directed and superintended and which should be the bureau of publication of the results obtained in them. The position of the central station in the country is of little importance in comparison with its permanence, endowment and freedom from all dangerous influences. Such conditions of permanence and freedom in this country will best be obtained in connection with one of the great endowed universities rather than with the national or with any state government, for political association is not conducive to the best scientific research, and for the next hundred years at least, and until a real knowledge of the vegetation of the earth has been obtained, the National Arboretum must be organized primarily for research.

By the information it could accumulate, such an institution would be able to aid the agricultural experiment stations and state universities, which are the natural and proper organizations for popularizing the results of long-sustained scientific investigations, for which they are not equipped and which, with the uncertainty of their resources, they cannot hope successfully to carry on. Forestry and landscape-gardening are based on a knowledge of trees, and in the study of trees are found pleasures which increase with knowledge and endure through life.

The Arnold Arboretum endeavors to popularize its knowledge by the publication of Bulletins of Popular Information and by courses of popular field instruction; and it should further be the duty of a national Arboretum to aid in the establishment of arboreta in connection with agricultural colleges and experiment stations, on the grounds of universities not equipped with botanic gardens, and on the grounds of high-schools. Collections of trees properly labeled are needed in every institution of learning and in every large center of population. Until such collections are established, the people of the United States can hope to know little of the beauty and value of their native trees and of those exotic trees which can safely be introduced into different parts of the country.

C. S. SARGENT.

ARBORICULTURE. Arboriculture is the growing or cultivation of trees. It is distinct from sylviculture, which grows trees in forest plantations for the production of a timber-crop. Sylviculture is a part of forestry.

What constitutes a tree is not easy to explain in a short and well-defined statement. A given species may assume a tree-like habit or remain shrubby, according to the climatic conditions, soil and other circumstances. Usually a tree is defined, under normal conditions, as a woody plant rising from the ground with a single stem and attaining a certain height, fixed by some at 20, by others at 15 feet, or even less. A more exact definition has been given by B. E. Fernow: "Trees are woody plants the seed of which has the inherent capacity of producing naturally within their native limits one main erect axis continuing to grow for a number of years more vigorously than the lateral axes and the lower branches dying off in time."

Trees are the most prominent feature of the vegetable world and surpass all other organic beings in height, magnitude and longevity. The greatest height known has been reached by *Sequoia sempervirens*, which attains 340 feet Not very far less is *Eucalyptus amygdalina*, of which the highest tree actually measured is given as 325 feet; it is, therefore, the tallest of the hardwood trees. The sequoias, however, are of more majestic and gigantic appearance than the eucalyptus on account of their massive trunk (see *Sequoia*). *Pseudotsuga taxifolia* and *Pinus Lambertiana* occasionally attain 300 feet. A number of other conifers, chiefly American, grow to a height of 150 to 300 feet. Some deciduous trees, as *Platanus occidentalis*, several species of oak and *Liriodendron Tulipifera* exceed 150 feet in height. The jequitiba of southern Brazil (*Couratari legalis*, one of the Myrtaceæ) is also a gigantic tree (see Bot. Gaz. 31, p. 352).

The greatest diameter has been observed in *Castanea vesca*, of which a tree with a partly decayed trunk at the foot of Mt. Etna in Sicily measures more than 60 feet in diameter. After this the greatest diameter observed is in *Taxodium mucronatum*, about 40 feet, and in *Platanus orientalis* about the same, in *Sequoia gigantea* 35 feet, in *Taxodium distichum* 30 feet, and somewhat less in *Adansonia digitata*.

The age attributed to many of the tallest trees is based more or less on speculation, and opinions often differ widely. *Dracæna Draco* is believed to reach 6,000 years of age, *Adansonia digitata* 5,000, *Taxodium mucronatum* and *Platanus orientalis* 4,000, *Cupressus sempervirens* and *Taxus baccata* 3,000, *Castanea sativa*, *Quercus pedunculata*, *Sequoia gigantea* and *Cedrus Libani* more than 2,000 years.

Although the trees are the most conspicuous features of the vegetable kingdom, they represent only a small percentage of it as regards the number of species. In the United States, where about 600 trees occur, they represent only about 3½ per cent of the whole phanerogamic flora, in Europe even less. As a rule, towards the tropics the number of tree-like species increases, towards the arctic regions it decreases. Remarkably rich in trees is the flora of Japan, where the proportion of trees to the whole phanerogamic flora is more than 10 per cent, which percentage surpasses by far that of any other country in the temperate regions.

Trees belong to many different natural orders, but of the orders of monocotyledonous plants only a few contain trees and none of them is hardy North. None of the larger orders contains trees only, but there are some which consist exclusively of woody plants and include a large proportion of trees, as Pinaceæ, Fagaceæ, Salicaceæ, Juglandaceæ, Magnoliaceæ, Sapindaceæ, Elæagnaceæ, Ulmaceæ, Hamamelidaceæ, Lauraceæ, Anacardiaceæ, Ebenaceæ, Styracaceæ and others.

The uses of trees are manifold, and a country from which the forests have been destroyed becomes almost uninhabitable and worthless to mankind. The forests furnish wood and timber, exercise beneficial influences on the climate, act as regulators of the waterflow, prevent erosion and also the removal of soil by the wind. Besides furnishing wood and timber, many trees yield other products of great economic importance, especially the numerous kinds bearing fruits. The æsthetic value also of the tree must not be underrated, although it cannot be counted in money.

The science of trees and shrubs is *dendrology*. The art of growing trees is arboriculture, while the rearing and maintaining of forests and the production of timber-crops is sylviculture. Arboriculture is sometimes used in a broader sense, like dendrology, to include also the growing of shrubs. Orchard culture is a branch of arboriculture or of horticulture, and deals with the cultivation of fruit trees; it is usually included under pomology, which comprises both the science and practice of fruit-growing.

As ornamental subjects, trees are more permanent, easier of cultivation and cheaper in the long run than herbs. It is curious to note how little attention the average gardener who has the care of a park or garden gives to the most prominent feature of his domain. He

IX. Arboretum.—Plantation of American oaks at the Arnold Arboretum; Solidago canadensis underplanting.

usually knows fairly well the greenhouse plants and herbaceous perennials, which cost most in time and money, but the trees and shrubs he often disregards. This is apparently due to the fact that after being once planted, and often not by himself, the trees and shrubs do not need his perpetual care, and usually grow without his aid and interference.

To the landscape gardener a thorough knowledge of trees is absolutely essential. He ought to know the ornamental properties of the trees, their rate and mode of growth, their peculiarities in regard to soil, situation and climate. As the trees are, after the surface of the ground, the most permanent element of the landscape, they ought to be planted with careful deliberation as to the intended artistic effect and their fitness to the soil and climatic conditions, for mistakes in planting of trees are afterwards not easily corrected and rarely without injury to the original artistic design.

The available number of trees from which selection may be made is large. There are in American and European nurseries and gardens more than 600 species in cultivation that are hardy in the northern and middle states. About 250 of them are American, more than 200 from eastern Asia, about 100 from Europe and 70 from western and central Asia. About forty natural families are represented, of which the most important are the Pinaceæ, Fagaceæ, Salicaceæ, Rosaceæ, Leguminosæ, Juglandaceæ, Sapindaceæ, Urticaceæ, Magnoliaceæ, and Oleaceæ. The number of all the cultivated varieties and garden forms is, of course, considerably larger than that of the botanical species and may be estimated at about 3,000. Comparatively few horticultural varieties are found in American nurseries as compared with European, but this need not be regretted, as horticultural varieties are mostly merely curious or monstrous forms. In planting, one must rely chiefly on the types and use the horticultural varieties sparingly, for restfulness should be the prevailing character of the masses and groups of trees.

ALFRED REHDER.

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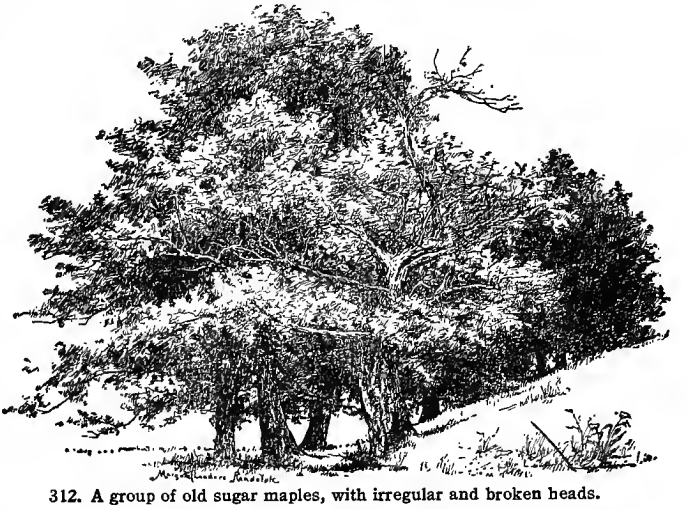
Choice of street trees for special regions, Mulford, page 374.
Ornamental trees for the middle and southern states, Berckmans, page 374.
Trees on the great plains, Bessey and Watrous, page 376.
Trees grown for shade and ornament in California, Davy and Morrison, page 378.

The cultivation of trees.

From earliest times man's instinct has been to seek the protection of trees. In locating his home the first necessity has been the proximity of water; second, pasture for his flocks; third, the presence of trees; in warm countries it has been necessary to provide protection from the hot sun's rays, in cool countries for the sake of fuel and protection from the elements. As civilization has progressed and man has developed more elaborate abodes, he still desires the protection of trees to make his home more comfortable, to protect it from the winter wind, or the summer sun, or both.

To meet the needs in different localities, as one or another protection may be more important, different kinds of trees are used. In the extreme North, the coniferous evergreens act as windbreaks twelve months in the year. In the south Atlantic and Gulf regions, the broad-leaved evergreens give shade the year through. In the intermediate country and overlapping both, the deciduous trees afford much summer protection and a little winter protection. The chief æsthetic value of trees is due to the suggestion of comfort that they give. In winter, a house snuggling against a group of evergreens may be attractive, and yet, if lacking a well-placed shade tree, may in summer appear glaring or otherwise uninviting. These feelings are the same with regard to native woodlands or man-made clumps more remote from dwellings. The different kinds of forest attract because of suggestions of comparative comfort and of pleasures. To those who have lived in the heart of a large city all their lives, such scenes are likely to be unattractive because of lack of suggestiveness. Some of the interesting and varied forms of trees are displayed in Figs. 312 to 359.

In planting trees for ornament, these elements of protection suggest two uses, that of windbreaks and that of producing shade at appropriate places. In addition are the partial hiding of buildings from important viewpoints, enhancing the beauties of the building or permitting only the most desirable features to be seen, covering the outlines of ugly buildings, or completely hiding objectionable objects, either nearby or distant; forming frames for distant views or nearby objects; making knolls and hills look higher by groves on their tops, or valleys look deeper because of wooded sides; making irregular sky lines either by accentuating existing conditions by planting tall trees on the high places and low trees in the low places, or in level countries making a similar sky line by tall and short trees; or forming irregular and natural appearing boundaries to lawns or meadows.



312. A group of old sugar maples, with irregular and broken heads.

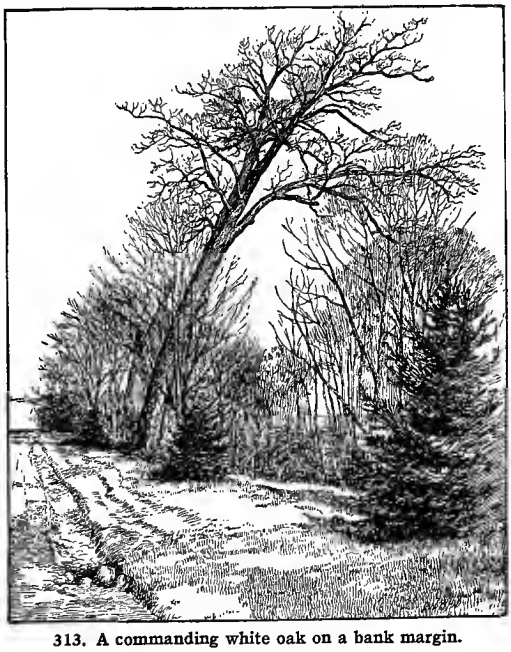
To accomplish any of these results, some trees are inherently better suited than others; climate and soil, however, may make their use impracticable or impossible. Coniferous evergreens make the ideal windbreak and screen, but they are satisfactory only in the northeastern section of the country and on the Pacific Coast, the hot sun of the South, the dry winds of the central plains and the smoke of cities making most species impossible in those regions. The broad-leaved evergreens are next in importance, but they are adapted only to the south Atlantic and Gulf seaboards, and the Pacific Coast north of San Francisco. For adaptabilities see special lists, for no other sweeping generalizations of adaptabilities can be made except that the use of bronze, yellow or variegated-leaved trees, and trees of unusual drooping habit or of other striking form, should be limited to special times and places. A tree to be satisfactory for ornamental planting must suit the

climate and maintain the appearance of healthy growth on the soil where planted, must be hardy, and must be free from serious insect and fungus attacks.

The location of trees is a detail of the design of the place. This is intimated in the preceding paragraphs and more fully discussed under Landscape Gardening, but a few cautions may be in order. Do not so surround the house with trees that they exclude all the sunshine. Except in the extreme South, use deciduous trees next the house so as to have full benefit of the winter sun. Plant the evergreens at a little distance. For specimen trees of the larger kinds, plant 50 to 100 feet apart, depending on the kind. For thickets and quick masses of foliage, the same kinds may be planted 15 feet apart. Theoretically, planting more trees than are ultimately necessary and then thinning is excellent. Practically, it is dangerous as there is not one chance in ten that it will be done in time. Plant irregularly both as to distance and direction unless the design is strictly formal, in which case plant with mathematical precision.

When and how to plant.

There is great difference of opinion as to the best time to plant. In climates with the temperatures of Boston, Rochester, Chicago and farther north, spring planting is probably best for most plants. Fall planting is increasingly more satisfactory as one goes south. On the western plains where strong, dry winter winds prevail and the soil is either so dry or freezes so hard that a newly planted tree cannot replenish the moisture taken out by the winds, spring planting is most successful. The character of soil may also have its influence. Magnolias and tulip trees should always be planted in spring. Coniferous evergreens should be



313. A commanding white oak on a bank margin.

planted either when growth has started in spring or, when vigorous, in late summer or early fall. Other evergreens should be planted when entering the period of most active growth so as to be able to form roots quickly to support the foliage that is always present. The period of generous moisture in air and soil is most favorable for the planting of evergreens. In adverse seasons, these conditions may be in a measure produced by liberal watering of the soil and frequent spraying of the tops. Deciduous trees should be planted when dormant, in order that roots may become well formed before there is foliage to support.

Large holes should be prepared for planting, at least 2 feet larger in diameter than the spread of the roots of the lifted tree, and 2 feet deep. If the soil is good, no further special preparation is necessary beyond a liberal mixture of well-rotted manure or raw bone-meal with the soil to be replaced in the hole, and supplying new topsoil to replace any subsoil excavated in digging the hole. In poor ground, a hole at least 6 feet across and 2 feet deep should be dug for a tree up to 8 feet high, and for larger trees proportionately larger holes to give them good ground for beginning growth. It is becoming common to dynamite holes for trees. Just how far this is desirable is yet problematical. In tough subsoils, it appears to be eminently successful. It seems reasonable to suppose that in most subsoils such a loosening would be permanently beneficial. Careful observers have noticed that trees usually thrive better on filled ground than on nearby soil where the land has been undisturbed, even though the fill appears poor in comparison. This does not have reference to city ash and garbage dumps. The ashes are too inert to support tree growth, the dump is frequently poisonous. In large plantings, the watering of deciduous trees and the staking of trees under 10 feet is usually omitted in the moist regions in which strong winds do not prevail, the replacing of any losses being considered more economical than this additional expense. Larger trees need special attention.

The size of trees to choose varies with the kind, the purpose, and the need for quick results. Trees may be successfully transplanted from one- or two-year-old seedlings to those 12 or 16 inches through and 40 feet high, success depending largely on the skill of the planter. Usually trees 6 to 12 feet high are best for deciduous trees, 3 to 6 for coniferous. Some species succeed better with small sizes, as tulip tree, magnolias and hollies. Nursery-grown trees that have been frequently transplanted are best, as they transplant with less loss because they have an abundance of fibrous roots. Collected stock of some kinds is satisfactory for mass-planting but the loss will run from 50 to 90 per cent, depending on kind and condition. Trees that are very small are not desirable to use, as they grow no better than larger nursery-grown trees and the cost of cultivation is more when planted permanently than when in the nursery row. Trees above the sizes mentioned are expensive to handle and the loss is likely to be greater. When immediate results are important, these are worth using with a mixture of smaller trees to take their place in case they should be short-lived.

Pruning and tree-doctoring.

At planting, all broken limbs should be removed as well as any crossing through the head or below it. If the top is still crowded, some limbs may be removed by cutting them off at the nearest fork. Heading-in or shortening the limbs is undesirable with most species. The magnolias and tulip tree are exceptions to this; they need severe shortening-in when transplanted. All roots should have the broken ends cut off with a smooth, clean cut, as this freshly cut surface seems to facilitate the formation of new rootlets or at least to prevent decay. If a newly planted tree is very slow in starting, it is sometimes induced to grow by a severe pruning.

Desirable varieties of shade trees seldom need any heading back. An annual inspection with slight pruning to shape the tree and remove surplus branches is all that will be required. A tree should be grown into shape, not pruned into shape, and should be allowed to develop its own characteristics.

Evergreen trees, with the exception of the evergreen oaks and *Magnolia grandiflora*, should be trained so that their foliage rises directly from the turf. As it

grows old, the white pine is likely to bare its trunk in spite of other training. Spruces and other coniferous trees are ruined if pruned to show the trunk. Figs. 318, 319. Many deciduous trees are also most attractive when their lower limbs rest on the ground, as beeches, the Norway maples, hornbeams and many more, any tree in fact whose natural habit will permit such a form.

Old trees, owing to neglect, or more often, improper pruning, frequently need the saw. Protruding stubs should never be left, whether the tree is large or small. The cut should always be made close to the remaining limb and parallel with it. It will not require over two years for the callus to show all around a properly made cut. If it does not show then, the work should be done over again. All dead wood should be kept out. Crossing limbs, even if large, should be removed. A tree should not be dehorned, i.e., cut back to stubs 3 or 4 inches or more in diameter, except as a last resort for a failing tree.

Pruning is employed for two distinct ends: to train and shape a young tree as it grows; and to re-form or adapt a tree of some maturity, especially if somewhat decrepit. The so-called "tree-doctoring" or "tree-surgery" is applied especially to the latter phase. A tree that has become weakened by transplanting, or from lack of proper nutrition, from lack of proper fertility, or scarcity of water, or from other undetermined causes, may often be forced into active vigorous growth by a severe cutting-back. It may even be allowable, in such cases, to pole or dehorn a tree; that is to remove most of the small limbs, cutting the large ones so close to the tree as to leave stubs as large as one's wrist or arm or even larger. It never happens that several trees in a row need such treatment unless their feeding-ground has been greatly depleted.

Trees that have been badly pruned, broken by wind, storms or otherwise bruised or mistreated, frequently have badly decayed spots in their trunks and limbs. It has become the custom to "doctor" such trees,—that is, thoroughly to clean out rotten wood, treat the exposed surface with a solution of corrosive sublimate or sulfate of copper to kill any fungous growth that may be present, with bisulfide of carbon or other insecticide for insects, and then coat the surface with tar as a preservative. After this the cavity is carefully filled with concrete of the strength commonly used in construction work. It is absolutely essential to success that the joint between the wood and cement be water-tight. The surface should also be given a smooth finish of the general outline that the tree would assume had it grown normally. The finished surface should coincide with the inner edge of the cambium layer so that the growth of the tree will proceed over the cement just as it would over a properly cut stub. Zinc caps are frequently used both to cover cement fillings to keep out the water and to cover large cuts when the wood is solid but when it will take several years to heal on account of the size of the wound. Cavities must be absolutely clean, thoroughly disinfected, and the filling positively water-tight or decay will begin behind the filling and the tree will be destroyed while every confidence is being felt that it is safe. The cement work is frequently reinforced with rods of iron. Its principal value is to hold the cement from cracking. The only value of such cement work is as a preventive of decay where there are cavities. When properly done, it gives a smooth surface over which the growth may proceed. The supporting value of the cement to the tree is slight.

With many hardwood trees in important locations such treatment is warranted, but at the present time many trees are thus treated that should be cut down, while many others are left that should have attention. The first requisite to warrant the treatment of a large cavity is a good type of tree in an important location, for example a large tree protecting the home from the mid-afternoon sun, or a bad individual in an avenue of otherwise good specimens. In large plantations, treatment of a preventive nature is of course warranted, but the filling of large cavities is not worth the cost except to those to whom money is little object. It is better to start new trees than to spend fifty dollars on patching up an old one. One must exercise careful judgment in selecting old trees for treatment, to make sure that the tree is worth it. Trees worth doing work on are the oaks, sugar, swamp and Norway maples, hickory, ash, elm and the slow-growing native trees. Those not worth treating in this way are the poplars, willows, silver- and ash-leaved maple and sycamore or plane

314. Picturesque old apple trees.

tree. A street tree with a large cavity would better not be doctored unless it is of special value and of a kind likely to last a long time.

Badly branched trees often show a tendency to split in the crotches. It is well to attend these trees before they begin to split and either chain or bolt the offending limbs together. They may be chained by putting lag-screws in the limbs, drawing the limbs together and dropping a link of the chain over the turned up end of the screw. Rods and turn-buckles may be used in the same way, the bolts for the rods being put through the limbs, not around them. Because bolts have to be placed closer to the weak point than the other remedies, they are not so effective but are often useful. If a tree splits, there is danger of decay. The splitting should be anticipated and prevented whenever possible.

The best time for pruning is not a question of invariable rule. The period of most active growth, in most places June, is usually regarded as the best time. The period of starting into leaf is probably the worst time, although the maples are about the only good shade trees that seem much affected by pruning at this season.

Large cuts or wounds should be immediately painted with a good grade of paint or with tar, care being taken to cover the exposed wood but not to allow the paint to come into contact with the cambium layer, or growing part of the bark.

Root injuries should be as zealously guarded against as injuries to the top. If a large part of the roots must be removed, the top should be correspondingly thinned. Changes of grade are a great source of damage to shade-trees, even when the roots are not actually touched. The filling of 2 or 3 feet of soil over the roots of a tree is, for most varieties, as sure death to the roots as cutting them off close to the trunk. This filling prevents the aëration of the soil and smothers the soil life on which healthy root-action seems to depend. This may be

prevented by a good layer of loose stones, open at intervals to the air, placed over the surface before filling, or, in some cases, by the use of agricultural tile drains on the old surface at close intervals and so arranged as to facilitate a free circulation of fresh air through the tiles.

Street trees.

In the development of towns and cities, the need of trees as a protection against wind has been reduced to a minimum since the closely built houses protect one another. This close building, however, has brought about another untoward condition that needs ameliorating; this is the replacing of the vast extent of green, common to the open country, by a motley array of discordant colors. Many of these colors have been demonstrated experimentally and practically to have exciting and debilitating effects on the physical condition of persons. Part of the great utility of parks is to afford urban residents relief from this color excitement. As far as possible, the soothing green needs to be

315. A group of surviving hemlock spruces.

taken into the city streets to rest the tired nerves through the effect on the eye. Also, the shade helps to reduce the temperature by absorbing the sun's rays; the large amounts of water the tree transpires also helps to cool the air. These beneficial effects make it worth while to expend effort and money to secure well-shaded streets. Figs. 323, 324.

The conditions in urban communities are adverse to tree growth. Streets are narrow and the trees crowded; roadway and sidewalk are paved with impervious materials preventing both water and air getting into the soil, and effectually keeping in sewer-gas and illuminating-gas that may be discharged into it from below. The air is dust-laden from constant traffic, and, what is far worse, contaminated by soot and poisonous compounds from numberless badly-fired chimneys. As though this were not enough, there are the self-styled tree-trimmers, knowing nothing of the work, then the linemen cutting ruthlessly, caring nothing for the tree, and with an occasional gnawing horse adding its demolition. And the sewer-layer, pipe- or conduit-layer and finally the curb-setter do their worst. After all of these, come the insects and diseases that affect trees everywhere and which here find an easy prey because of the fewer birds in city streets and the weakened condition of the trees.

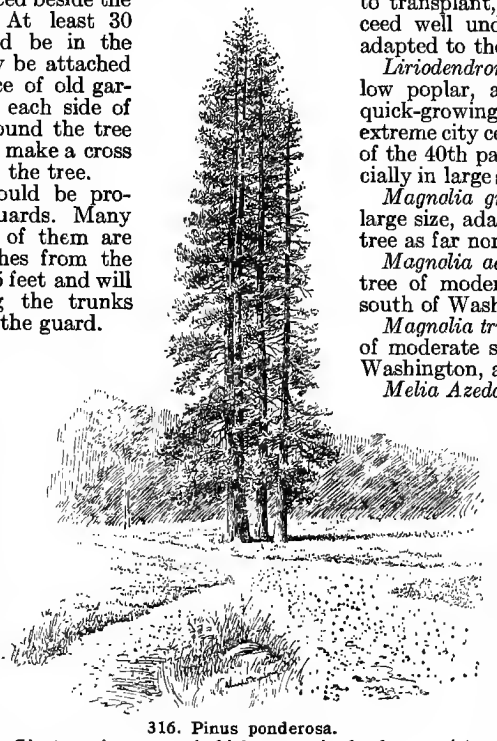
The first essential to successful street tree-planting is competent municipal control of all such work. The street trees should be under the care of an unpaid commission of three or five men, one named every two years by a local court, or by the mayor, for a term of six or ten years, and confirmed by the legislative body. Such commissioners usually need to be trained, and therefore they should have considerable experience in their work before coming into full responsibility. The restrictions on the appointment of the executive officer should be stringent, so that only thoroughly trained and experienced men could be employed. The expert should have the full confidence of the commission and be the leader in the work. To fill such a position, a man should have thorough knowledge of trees and the soils and conditions under which they grow, their characteristics, æsthetic values and habits of growth under city conditions, the methods of aiding trees to withstand these conditions, and a knowledge of the insects and diseases to which the different species are liable and the methods of combating them. The work is neither forestry nor pomology, as it has nothing whatever to do with the products of tree growth or the growing of trees for their fruits.

Powers vital to the success of this commission are the right to plant suitable kinds of trees in a proper way, and to collect benefits for work so done; to control absolutely all pruning, removal and care of trees; and the right to invade private grounds for the control of insects and diseases. Of course, sufficient funds must be available to support the work.

Many city streets are too narrow from building-line to building-line for satisfactory planting. There is absolutely no excuse for this in the newer sections. There should be at least 100 feet from building-line to building-line on any street and on principal streets considerably more. Forty feet may be all that is needed for roadway and sidewalks, at present. The abutting dwellers need the air-space provided by the remaining area which is legitimately used as front lawns. This will leave ample space for trees. If the city grows and more space is needed for traffic, it can be secured with no sacrifice to buildings and the dwellers in the interval have had better living conditions. It is this arrangement that makes Washington such a beautiful city, and the lack of it on Fifth Avenue that is costing New York City so much money to widen that thoroughfare. In the older parts of cities, species must be chosen that are appropriate to the width of the street. Most kinds should be planted not closer than 40 feet apart and such varieties as oaks, elms and sycamores would be better at 50 feet. Most planters use 35 and 40 feet because of the public demand for quick shade, and at the greater distances the trees look far apart when first planted. Theoretically, the planting double the number of trees needed at maturity or the placing of fillers of a quick-growing inferior type, is desirable; but practically it is dangerous, as there are not many cases in which public opinion will tolerate the thinning at the proper time. In city work an excavation 2 feet deep, with the removal of at least 2 cubic yards of dirt, should be made for each tree. This should be filled with good top-soil mixed with well-decomposed manure. Of most varieties, trees 10 to 12 feet high and 1½ to 2 inches caliper should be used. These should be nursery-grown. They should have been frequently transplanted and have a well-developed head, 6 to 8 feet from the ground. The roots should be abundant and fibrous. In planting, the roots should be spread out and separated to their full length, the ground worked all in amongst them, and then thor-

oughly firmed by tramping. Before the hole is completely filled, the tree should be well watered and the remainder of the soil put in loosely. A strong stake 8 feet long should be placed beside the tree when planted. At least 30 inches of this should be in the ground. The tree may be attached to the stake by a piece of old garden hose attached to each side of the stake and put around the tree in such a manner as to make a cross between the stake and the tree.

All young trees should be protected by boxes or guards. Many forms are used. Any of them are good if the box reaches from the ground to a height of 5 feet and will prevent horses biting the trunks and boys swinging on the guard.



316. Pinus ponderosa.
Giant specimens 225 ft. high, grown in the deep, moist soil of the Yosemite Valley.

Notes on ornamental trees.

Acer Negundo (box elder). Too short-lived, brittle and subject to insect attack. Its use may be warranted in semi-arid and very cold regions.

Acer platanoides (Norway maple). Moderate grower, healthy, but too dense for close city streets.

Acer rubrum (swamp maple, scarlet maple). A good-sized tree, good grower, fine foliage, especially brilliant in autumn. Also a bright red in spring due to blossoms and young leaves. Not suited to the interior of large cities.

Acer saccharinum (silver maple, soft maple). Rapid grower, but too brittle and short-lived, and the shallow roots prevent the growth of grass under it and also destroy sidewalks.

Acer saccharum (sugar maple). Does not thrive on heavy clay soils or under severe city conditions but most excellent where it does grow. Moderate grower, doing best north of the 40th parallel.

Ailanthus altissima (ailanthus, tree of heaven). A large, handsome tree, the staminate and pistillate flowers appearing on different trees, the latter very ill-smelling. A most useful tree in the center of large cities. The staminate form only should be planted.

Celtis mississippiensis (southern hackberry). An excellent tree in those regions in which the "witches-broom" does not attack it. One of the promising trees to withstand the hot winds of the plains as far north as Denver. A large tree and good grower.

Celtis occidentalis (hackberry). A good tree where the disease known as "witches' broom" does not attack it. It is for regions north of the 36th parallel what the foregoing species is for the region south of it.

Fraxinus americana (ash, white ash). A good tree for suburban conditions. Moderate grower, attaining large size.

Ginkgo biloba (ginkgo, maidenhair tree). An excellent tree of peculiar pyramidal form when young. Moderate grower, attains good size and is free from insect and fungus attacks.

Gleditsia triacanthos (honey locust). A large, quick-growing, handsome tree. Except for its thorns, this tree would probably be a most desirable tree for the semi-arid regions of the West. There is a thornless form that may sometimes be obtained, which is good.

Liquidambar Styraciflua (sweet gum). A handsome and valuable native tree but little used. Moderate grower, good size, handsome fall coloring. A little hard to transplant, especially in large sizes. Does not succeed well under extreme city conditions, and is not adapted to the extreme northern sections.

Liriodendron Tulipifera (tulip tree). Miscalled yellow poplar, and tulip poplar. A handsome, large, quick-growing tree, little used, but valuable except for extreme city conditions and much of the country north of the 40th parallel. A little hard to transplant, especially in large sizes, and should be moved only in spring.

Magnolia grandiflora. A broad-leaved evergreen of large size, adapted to the extreme South. A good lawn tree as far north as Washington.

Magnolia acuminata (cucumber tree). A handsome tree of moderate size, good for suburban conditions south of Washington and St. Louis.

Magnolia tripetala (umbrella tree). A handsome tree of moderate size, good for suburban conditions south of Washington, and St. Louis.

Melia Azedarach (umbrella tree). A small, attractive tree, good for temporary effects from North Carolina south and west.

Nyssa sylvatica (sour gum, tupelo). A large, handsome tree, adapted to suburban conditions. Brilliant fall foliage and winter berries.

Platanus occidentalis (sycamore, buttonwood). A large tree, rapid-growing, open-topped, and almost scraggly in its growth. Considered an untidy tree by some on account of its seed-balls and the bark which is shed in large flakes. The white trunk, after the bark is shed, is unusual and attractive. In some regions it is subject to a blight just after the leaves start in spring. A good tree for severe city conditions.

Platanus orientalis (plane tree, oriental plane). A more compact grower than the foregoing and a little better suited to street purposes, but not quite so rugged and imposing as the foregoing. An excellent street tree.

Populus deltoides, including var. *caroliniana* (cottonwood and Carolina poplar). These two trees are much used for street planting in many places but are entirely unsuited for the purpose. Although the growth of a severely pruned tree is large in any one year, it is the custom to remove a half of this each year so that the net gain in growth is no more than an average tree. Even with this pruning it is liable to be broken by a moderate wind storm, and without the pruning it is even more liable to be broken. Their roots are as bad as willow roots about finding and clogging sewers. Wide-awake cities prohibit the planting of these trees.

Populus nigra var. *italica* (Lombardy poplar). A tall, short-lived, fastigiate

317. Conifer forms — Pine and spruces.

tree, suitable for narrow streets in the heart of a large city.

Quercus alba (white oak). A most picturesque tree, attaining the largest size. The gem of American trees, and not so slow-growing as usually considered. Dead leaves hang on most of the winter. Figs. 313, 322.

Quercus bicolor (swamp white oak). A large, handsome oak of moderately rapid growth, suited to moist situations. It seems to succeed under city conditions. A desirable shade tree, almost as handsome as the white oak and a little faster grower.

Quercus coccinea (scarlet oak). Comparable to the red oak but not quite so sturdy and vigorous under all conditions, but with a little more brilliant autumn coloring and leaves more finely cut.

Quercus laurifolia (laurel oak, water oak). The standard street tree for the South. A large, handsome, deciduous tree, not so desirable as the live oak, but of more rapid growth.

Quercus Michauxii (cow oak). A good oak for thin gravelly lands. Not so desirable as the other oaks on

318. Spanish Fir.—Abies Pinsapo, showing the verdure from top to base.

good ground and not adapted to the extreme northern sections.

Quercus macrocarpa (mossy-cup oak). A handsome and satisfactory tree, not so large as some of the others. One of the most promising for the plains.

Quercus nigra (possum oak, water oak). Another good oak south of Norfolk. A little more upright in growth than *Q. laurifolia*, but not quite so desirable except possibly in its more northern limits.

Quercus palustris (pin oak). A quick-growing, good-sized tree, with pendulous branches when old. Handsome cut leaves, brilliant in autumn. One of the best. Its pendulous branches may sometimes be a rather serious objection. Dead leaves hang on well into the winter. Fig. 323.

Quercus phellos (willow oak). A large, handsome tree, moderately fast-growing, satisfactory south of Washington in regions in which it is not attacked by a growth resembling "witches' broom" of the celtis.

Quercus rubra (red oak). Almost the best street tree. Large, symmetrical, rapid in growth, fine autumn foliage, head not too dense. It is exceeded only by the elm in rapidity of growth among the trees suited for street planting and not by that in the southern half of the country.

Quercus virginiana (live oak). A large evergreen. The best street tree for the South, but slower in growth than *Q. laurifolia*.

Sterculia platanifolia (varnish tree). A small tree of reasonably rapid growth bearing bright yellow flowers. It has a tropical suggestion. Good only for the South and its principal value is in its possibilities for the Southwest, especially semi-arid Texas.

Tilia americana (basswood, American linden). A large, handsome, quick-growing tree. Young trees are sometimes affected by a disease at the base of the trunk, but the tree is well worth growing except in regions in which the difficulty is known to be present.

Ulmus americana (elm, white elm). The shade tree of New England and deservedly ranked first there. It loses its preëminence as one goes from New England, but a large, quick-growing tree worth using except in the extreme South. Drops its foliage too early to be the ideal shade tree in the middle states and southward. It is subject to the attacks of the elm-leaf beetle in regions in which that has been introduced.

F. L. Mulford.

The conifers in particular.

The cone-bearing trees (*Pinaceæ* and allies) are decidedly the most important order of forest trees in the economy of civilized man. They have furnished the bulk of the material of which our civilization is built. The remarkable combination of strength and stiffness with the smallest weight compatible, and the abundance and gregariousness of their occurrence, give them this important position.

From the standpoint of the horticulturist, the conifers also take a prominent place among the materials for landscape gardening effects, and, in the more practical use, as windbreaks. Their evergreen habit—for all except the larch and ginkgo tribes are evergreen—and their conical form, especially in earlier periods of life, with a branch system persisting to the base for a long time, are the elements that make them desirable. To these graces may be added the peculiar form and striking coloring of their foliage, which, in combination with deciduous trees or in clumps by themselves, or in single specimens, offer striking effects.

There are two types of natural or native beauty in the conifers—the symmetrical and verdurous beauty of the young specimen (Figs. 318, 319), and the picturesque and rugged beauty of the old and timeworn tree (Figs. 315–317). Aside from these, there are also odd, grotesque and formal cultivated varieties, as typified in the weeping spruce (Fig. 320), the columnar junipers, and the various dwarf pines and spruces.

The majority of the species belonging to this group, as well as their greatest numerical development, is found in the temperate zones, only a few belonging to subtropical or tropical countries, among which are the araucarias, from South America; the dammara, dacrydium, and phyllocladus, from Australia, and neighborhood.

Kinds and adaptations.

The order Coniferæ comprises nearly 40 genera, and about 300 species. Our own native flora, with 15 genera and not less than 100 species and subspecies, is among the richest, the bulk of these being found on the Pacific coast. The Altantic side offers 28 species, representing the genus Pinus with 12 species out of 39; 1 Larix out of 3; 3 Piceas out of 7; 2 Tsugas out of 5; 2 Abies out of 12; 1 Taxodium; 1 Thuja out of 2; 1 Chamæcyparis out of 3; 3 Juniperus out of 11; 1 Tumion (Torreya) out of 2; 1 arborescent Taxus out of 2: being without representatives of the genus Pseudotsuga, Sequoia, Libocedrus, and Cupressus. There are to be added a large number (not less than 400) of nurserymen's varieties, some of which have been enumerated in Bulletin 17 of the Division of Forestry, United States Department of Agriculture.

There are also a number of exotic conifers that promise satisfactory results if used in suitable localities, climate and soil. The Norway spruce (*Picea ex-*

celsa, Fig. 356) recommends itself by its elegant gothic form, often with pendulous branchlets, its very rapid growth, and its wide adaptation to soils and climates, together with its ease of propagation and cheapness. It excels most of the American spruces in form and rapidity of growth. Like all conifers, after the twenty-fifth to fortieth year it must pass through a period of change in form, during which it loses, for a time, its shapeliness. The Scotch pine (*Pinus sylvestris*) has nothing to recommend it which may not be found in native species, except, perhaps, adaptation to the dry climate of the West, and cheapness. The Austrian pine, on the other hand, is an acquisition by its stout growth in its youth, although the red pine (*Pinus resinosa*) would probably do as well; so far, its small cones and seed have made the latter expensive. The European larch outgrows the native northern one easily, but *Larix occidentalis*, from the interior basin, will probably do as well or better. There is no particular commendation for the European fir, but the Nordmann fir, from the Caucasus, is a most decided aquisition, by its beauty and adaptation; so is the most graceful of all spruces, *Picea orientalis*, while the Spanish *Abies Pinsapo* (Fig. 318) will always attract attention by its peculiar shape and foliage.

Of other ornamental forms that are without repretatives in the United States and hence fill vacancies, may be mentioned as capable of adaptation and more or less in use, from South America, the araucarias; from Africa and eastern Asia, *Cedrus Deodara*, *libani*, *atlantica*, *Abies Apollinis* and *cilicica;* from Korea, the promising, more densely foliaged white pine, *P. koraiensis;* from China, Cunninghamia, Biota, Glyptostrobus, Cephalotaxus, Podocarpus, Pseudolarix, and, above all, that interesting remnant of former ages, the maidenhair-tree, *Gingko biloba*, which will maintain itself anywhere along the Atlantic coast if propagated from seed of the proper localities. Japan has furnished a number of additions, especially retinosporas, torreyas, taxus, various pinus, piceas and tsugas, with the peculiar *Sciadopitys verticillata*, the umbrella pine, and, the most acceptable of all, the graceful *Cryptomeria japonica*.

As with all introductions from one country to another, nay, from one climatic region to another, caution is advised, so it may be laid down as a rule, that exotics should be used with great discretion, and, until their adaptation is amply demonstrated, only in a subordinate way. If it is in general true that perennial plants can be transplanted with permanent success only into similar climatic conditions, it must be especially true with the conifers, which do not lose their foliage, and hence must be able to bear summer as well as winter conditions. The long-leaf pine of the South, most striking of our pines, may, therefore, not be transplanted far beyond its northern limit, and, if one desires to utilize any of the Pacific coast species in the East, one will have to secure them at least from the highest and driest altitudes and exposures, or if, as in the case of some species, like the Douglas fir and Engelmann spruce, their field of distribution covers the dry slopes of the Rocky Mountains as well as the moist slopes of the coast ranges, one may be successful if one chooses the plant material from these drier slopes.

Of the many native species, a number that are not of any particular value may be discarded, although the distinction could be more readily accomplished from the economic point of view than from the standpoint of the horticulturist and landscape gardener, for almost every one has a distinctive feature of either form or adaptation to soil or other interest. For each climatic region the choice must be different; hence it would be impossible to give, in the brief space of an article, intelligent advice as to best selections. In general, besides climatic limitations, the following considerations may serve in the choice of native species:

The pines, as a rule, are not to be placed on compact clay soil, and on account of their taproot, not on shallow soils, on which they soon become spindly; they thrive best on loose, sandy soils, and can endure dry soils, the white pine adapting itself perhaps best to the clay soils without detriment to its development. On wet soils pines are, as a rule, decidedly out of place, although the red pine (*P. resinosa*), of the North, and the loblolly (*P. Tæda*), and some other southern species are capable of supporting such conditions. For such situations here, however, the cedar tribe furnishes better material,—the chamæcyparis, thuyas and taxodium. These trees of the bog and swamp are, however,—it should not be overlooked,—capable of thriving even better on drier soils. They are merely indifferent to moisture conditions at the foot.

The shallow-rooted spruces are trees of the higher mountain ranges, and are, therefore, more adapted to moist and cool situations, although some of them, the

319. A well clothed conifer.—Abies venusta.

Norway spruce, the blue spruce of Colorado and the northern white spruce will—the former, at least, during its juvenile period—endure more droughty situations. The firs, too, are rather more species of northern climates and high altitudes, the red fir, so-called (*Pseudotsuga taxifolia*), which is not a fir proper, being, perhaps, best capable of supporting drier and hotter situations. The most ornamental, and, in many respects, most serviceable of the firs, *Abies Nordmanniana*, from the Caucasus, develops its magnificent dense and dark green foliage in the warm but moist climate of Washington, while our most ornamental *Abies concolor* from Colorado will thrive even in the drier atmospheres of the middle states. The fine firs of the Pacific coast will probably not thrive anywhere in our drier and hotter eastern climates for any length of time, unless placed in cool and shady situations.

The Douglas fir (*Pseudotsuga taxifolia*) is, perhaps,

most readily acclimated if seed is secured from the dry slopes of Colorado. The Lawson cypress (*Chamæcyparis Lawsoniana*), with its graceful pendulous branches and foliage, and the pyramidal *Libocedrus decurrens* are unquestionably desirable additions to our ornamental stock, while the sequoias, especially *S. gigantea*, the big tree, seems not to be able to support persistently our eastern climate.

One important feature which enters into consideration when grouping conifers is the relative endurance of shade or tolerance which the species exhibit, thereby indicating their use in various positions. The yews and firs are the most tolerant of shade, together with the hemlocks; next may be placed the spruces, arborvitæ (Thuya), and junipers, while the pines are mostly intolerant of shade, excepting the white pine, which is the most shade-enduring of the pines; the larch and the bald cypress are the most light-needing of all, and will perish soon if placed under the shade of any other trees. All species, to be sure, are capable of more shade-endurance when young and on deep, moist soil. Their relative shade-endurance under the same conditions remains, however, the same, and may be studied in the forest by observing the density of the individual crowns, the capacity of maintaining a thrifty foliage under the shade of different species, and especially of young plants to persist in such shade.

320. A "weeping" or drooping form of Norway spruce. This is a so-called horticultural variety, to be planted only sparingly.

Propagation.

Most conifers ripen their fruit in the fall, September to November, and are best gathered soon after or before ripening. The pines require two years (some three years) to mature their cones. White pines ripen fruit in the first two weeks of September, and the cones opening shed the seeds at once, the empty cones remaining on the branches. The cones of the firs fall apart upon ripening, hence must be gathered before being quite ripe. Spruces and hemlocks shed seeds from time to time, opening and closing their cones according to the weather through the winter into spring. Some pines, like *Pinus pungens* and *P. serotina*, keep their cones closed for years, and artificial heat must be employed to make them open and give up their seed. In gathering seeds for the trade, such artificial heat is frequently applied with pines in specially constructed seed-roasters; such seed should be carefully inspected, as it sometimes suffers from improper use of the heat.

The proportion of germinating seeds, and the vitality, i.e., the ability of retaining germinative power, varies greatly not only with the seasons in the same species, but from species to species.

The lowest germination percentage and vitality is found in firs and larch, which show rarely more than 50 per cent of good seed, and soon lose their vitality, while spruce and pine, when entirely fresh, may show as much as 95 to 100 per cent germination, and retain vitality for two to five years, losing each year a proportion, Norway spruce five years old still having 10 per cent germination.

In trade, a germination percentage for spruce of 75 to 80; pine, 70 to 75; fir, 30 to 50; larch, 20 to 40, should be acceptable.

Seeds are best kept in a dry, cool garret in tight bags or boxes, excluding the air as much as possible.

All seeds require a short rest or after-ripening of two to four weeks before they are ready to germinate, and some, like the taxus and juniper, lie over, even in nature, for a year or more before they germinate. The latter should be prepared for sowing by macerating them, and removing the pulp in hot water, then mixing with sharp sand in bags, and by friction freeing the seed from the pulp.

In the seed-bed somewhat more care is required than with most other species of trees. A thoroughly mellow, well-pulverized seed-bed of light loamy sand, possibly enriched with well-decomposed manure (cow-dung better than horse-dung) is required, the covering of the seed varying, according to size, from a mere sprinkling for larch to ¼ inch for the heavy-seeded pines. They may be sown as soon as the weather is settled, in northern latitudes the second or third week in May, best in rows not more than 6 inches apart, and preferably in dry weather, when the soil does not clog, for clogging or baking of the earth sometimes prevents seeds from germinating. Mulch between the rows with pine needles or sphagnum moss, or other fine mulch, to reduce necessity of watering and weeding. Conifer seeds need very little water for germination. The seedlings, on the other hand, for the first three months, until they have made their crown bud, need to be either kept well watered or else protected against the drying effects of sun and wind by shading, for which purpose lath screens are best. These latter must be lifted for airing after the sun is gone, especially in muggy weather, to avoid damping-off. For wintering, a covering with conifer branches or very clean meadow hay is advisable (the latter is likely to bring in weeds).

For growing small quantities, the use of boxes, as described by Jackson Dawson, of the Arnold Arboretum, in Proceedings of the Massachusetts Horticultural Society, is highly commendable. In well-drained boxes, sow the seed soon after gathering, pile four or five deep in a pit or sheltered place, cover with boards, and when cold weather comes, cover up with leaves or hay. About the middle of April, move them into a place where they get the early morning sun. Keep the seedlings well watered and free from weeds, and shaded as described. Winter the seedlings in same manner as the seed-boxes,

321. A "weeping" tree, representing a grotesque horticultural variety.—Ulmus scabra var. horizontalis.

well covered up. They are ready for transplanting next spring, when they are making their first or second set of true leaves.

Since pine and spruce seedlings take about seven to ten pounds of phosphoric acid, ten to twenty pounds of potash and fifteen to thirty pounds of lime, besides

twenty pounds of nitrogen, per acre from the soil, for continuously used nurseries the addition of mineral materials in the shape of bone-meal and wood-ashes may become desirable.

A large number of seedlings may be grown in a small space; thus 30,000 Norway spruce may be grown on a square rod, requiring about two pounds of seed. The quantity of seed sown depends, in part, upon the length of time it is expected to leave seedlings in the seed-bed, besides size and quality of seed; the quantities vary from one-fourth to one-half pound per 100 square feet if sown in drills, and the yield of seedlings will vary from 2,000 to 25,000 seedlings, according to species and seasons.

Transplanting and pruning.

Conifers, like any other trees, may be transplanted at any time of the year, provided the necessary care is taken in moving the plant. This care is least required, as with other trees, in the fall and early spring, when activities of root and foliage are, if not at rest, at least reduced. Which of these seasons is preferable depends on the locality, and the dependent character of the season. On the whole, spring planting will probably be preferable in most parts of the United States which do not suffer from dry spring winds. In localities of the Southwest, which have commonly a dry spring followed by a rainy season in July, this latter time

322. An ideal shade tree.—White oak.

should be chosen. There is a belief that planting in August is specially favorable. There is no reason for this belief, unless favorable weather (a rainy season) follows.

Conifers may be transplanted later than deciduous trees, even after the buds have started, excepting the larch, which buds out very early; with this species, fall planting may be recommended. Cloudy weather, rather than rainy or very dry, should be chosen, especially when transplanting into nursery rows.

Young trees are naturally more readily and successfully transplanted than older ones, with which there is more difficulty in securing the whole root-system when taking them up. Since, however, the seedlings develop slowly for the first one or two to three years, they should be left in the seed-bed for that length of time, root-pruned, and then transplanted into nursery rows. Although those with a shallow root-system, like spruces and firs, may be moved even when 30 to 40 feet in height, it is best, even for ornamental purposes, not to take them more than 3 to 4 feet in height. In forestry, one- to four-year-old plants, according to species, from 2 to 12 or 15 inches in height, are preferred for reasons of economy.

Much greater care than with deciduous trees is necessary, when transplanting without an earth-ball, in keeping the root fibers from drying out; a large amount of loss in transplanting is explained from neglect in this respect. As soon as taken up, the roots should be

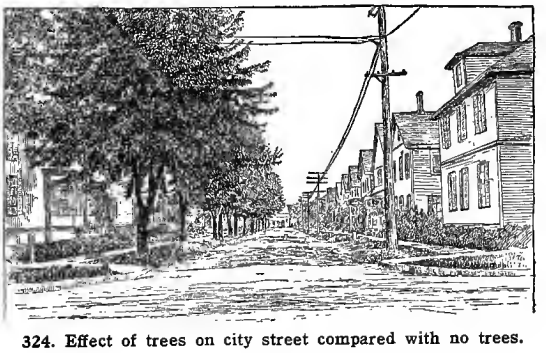
323. Good street trees.—Pin oaks.

immersed into a loam-puddle, or kept protected by wet sphagnum moss or canvas until set into their new place.

The question of trimming when transplanting must be considered with more care than is necessary with broad-leaved trees, which possess much greater recuperative power. It should be confined to the smallest amount, smoothing bruised roots, and if for proper proportioning pruning at the top becomes absolutely necessary, shortening the leader rather than branches. Larch will stand more severe pruning than most other conifers. From the artistic as well as physiological point of view, it is barbarism to remove the lower branches, which the tree needs to shade its trunk and standing room, and often, when deprived of the same, will replace first before starting again, in its height growth. Attention should, however, be especially paid to preventing double leaders, which are detrimental to future form-development; cut them out as early as possible, preferably in the bud. Laterals may be somewhat shortened-in while standing in the nursery, to lengthen the time during which the lower branches are to persist. Breaking out buds is, as with all trees, the best method, provided the pruner has an eye for his business. Even in after-life, when pruning is performed to keep the tree shapely, the minimum use of the pruning-knife should be the rule.

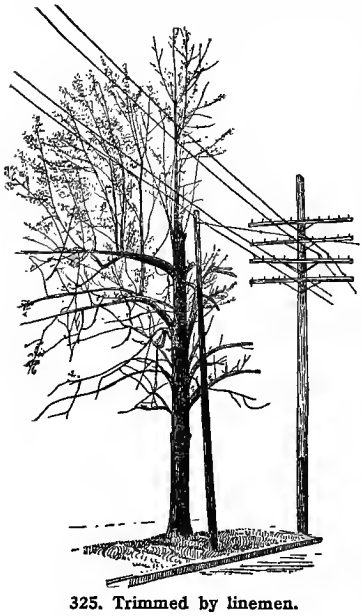
There are three marked periods in the development of conifers—the juvenile period, when the entire tree is a crown, branched symmetrically to the base, the perfection of symmetry; then follows the adolescent stage, when the lower branches die out, a period of unshapeliness; followed by the virile stage, when the straight, cylindrical shaft bears the crown at one-third or one-half of the upper length of the bole. The trimming during the adolescent stage requires most consideration. It is, in most cases, best to take off only the lowest, dying or dead branches, as it becomes necessary.

In pruning, cut as closely as possible to the trunk,



324. Effect of trees on city street compared with no trees.

even cutting into the bark, also removing the swelled portion on which the branches are usually inserted, when the callousing will be more rapid and satisfactory in shape.



325. Trimmed by linemen.

If at this stage or at any time, the trees show trouble at the top by drying (becoming "stag-headed"), it is a sign that they suffer at the root from lack of moisture. Trimming off a few tiers of lower branches, loosening the soil as far as the ambitus of the crown, and mulching will largely correct this. If this proportioning of crown to root is not done, the tree itself will do it and not necessarily in desirable form. When used for hedges, the treatment is, of course, different. For such a purpose the shade-enduring species, spruces and hemlocks, are best, since they are capable of preserving a dense interior foliage, while the pines are bound to thin out.

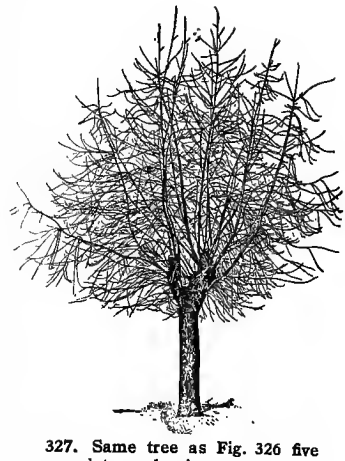
Enemies.

There are a number of dangers and damage from insects to which conifers are exposed. Drought and frost are most dangerous to seedlings in the seed-bed. These are obviated by proper location of the seed-bed (protection against sun and wind), by covering with a mulch of moss, straw, pine-straw or the like (which also prevents the heaving out by frost and the washing out by rain, to which young seedlings are liable). By shading and watering the danger of drought is overcome, although at the same time that of damping-off is invited. The cause of this disease, consisting in the reddening of the needles and their falling off, is a fungus which can be combated by spraying. Birds may be kept away from the seeds by mixing them with red oxide of lead, by lath screens, and the usual methods.

326. Showing need of city control. This tree on a city street being trimmed for firewood.

Various fungi and insects, too many to mention, some polyphagous, others more or less specific, are at work during the various stages of development. A host of leaf-miners, sawflies and caterpillars destroy the foliage, and weevils sap the young shoots. Bostrichi, or bark-beetles, mine under the bark, mostly of trees that are sickly from other causes; borers enter the wood of the boles. Tortrices bore into the base of leaders and cause them to break off. The best remedies against most of these are preventives, namely providing the trees with such chances of vigorous growth, or satisfactory soil conditions, that they are able to ward off or overcome the enemies. Otherwise, watching and destroying the enemies in time, and the usual remedies to kill them, may be employed. Literature: Veitch, "Manual of Conifers;" Carrière, "Traité des Conifères;" Beissner, "Handbuch der Nadelholzkunde;" Fernow, "Care of Trees.

B. E. Fernow.



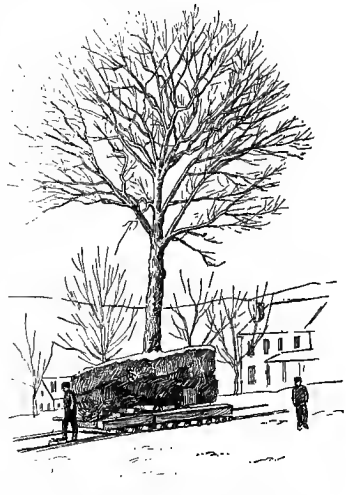
327. Same tree as Fig. 326 five years later, showing unattractive bushy top, and bad stumps that will decay instead of healing.

Transplanting large trees (Figs. 328–332).

Moving large trees divides itself into two classes: First, with a ball of earth; second, with the earth dissected out from the roots with or without a ball remaining in the center.

Start at or near the ends of the roots where they are 1 inch in diameter or less. In practice, this results in about 30 feet spread of roots on a tree 12 to 15 inches in diameter. An elm 18 inches in diameter on very thin gravelly soil was found to have a root 6 inches in diameter at 15 feet from the trunk, extending toward a horse-shed and cultivated field where it would get more food and water. A trench is dug to below the roots, which may be 1½ or 3 feet. An under-cut is made and the soil caved down by a picking bar or fork with round pointed tines. The earth and roots will be mixed at the bottom of the trench. The roots must be carefully picked up with the fingers, bound in bundles and tied out of the way. This operation is the point of greatest failure as it takes considerable time, patience and skill, to avoid breaking the roots. There are many chances to break a root after it has been carefully dissected out. The roots must be promptly lifted up or they will be broken by the shovel in digging out the loose soil at the bottom of the trench. The bundles must be untied and rearranged where the roots cross. This proceeds until a tree is dug in to a ball about 6 to 8 feet. The tree is then tipped over by tackle, cleaving the roots from the subsoil.

The amount of earth left in the center depends upon the strength of the truck, character of the roads and power for

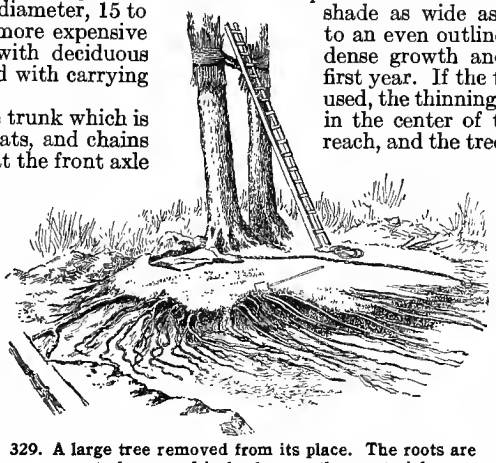


328. Moving a tree in winter, with a large ball of frozen earth.

hauling. To leave a mass of earth 6 to 7 feet wide, 15 inches deep, is practicable with two teams and 6-inch tires over hard dirt roads. Such a ball is helpful because there are more roots left undisturbed and they help support the tree during the first summer, especially if the ball is kept to the proper degree of moisture. Larger balls, 8 and 10 feet in diameter, 15 to 20 inches deep, can be carried only by more expensive trucks with much wider wheels, and with deciduous trees the advantage is slight as compared with carrying a full circle of roots 30 to 40 feet wide.

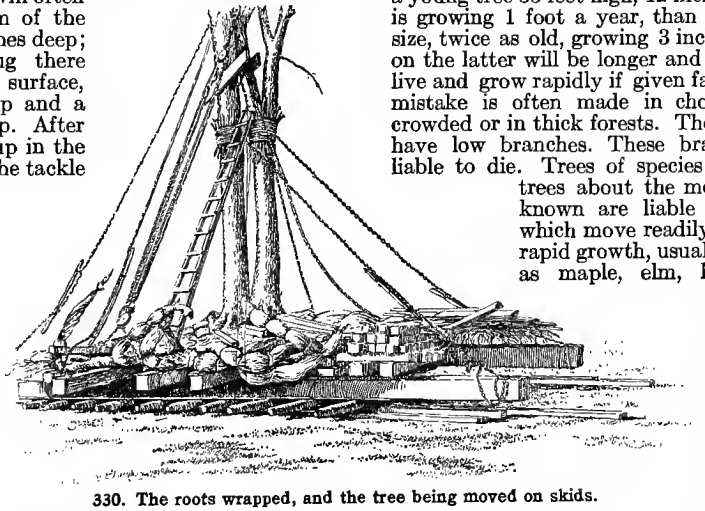
The trees are readily picked up by the trunk which is protected by cushions and clasped by slats, and chains tighened by screws. A cradle is hinged at the front axle and tips the tree over in a horizontal position which is necessary on account of overhead wires and bridges. There are one or two screws about 9 feet long, 2½ inches in diameter. Tipping is accomplished by these screws or tackle or both. The roots on the lower side of the tree are tied back underneath the axle.

In transporting, the roots are wrapped in straw and burlap. They can be exposed to the air for a day without serious injury, as roots ⅛ inch in diameter do not get dried out and killed in that time. In passing under wires, these can be lifted by a T-shaped pole and disentangled from the branches by proceeding a few feet at a time. Dangerous high tension electric wires must be handled by linemen employed by the electrical company. It is sometimes necessary to raise the wires or take them down and drive over them.



329. A large tree removed from its place. The roots are now to be wound in burlap or other material.

In planting, the truck is drawn into the hole and stopped at such a distance from the center that the tree when swung over will be in the right position. The holes should be made of such a depth as to keep the roots as near the surface as possible. Allowance must be made for the bending of the downward roots below the center of the ball. The most frequent mistake is to get the tree too deep, especially the roots at the outside of the ball, which will often drop to the bottom of the hole and be 18 inches deep; whereas when dug there were some at the surface, some 6 inches deep and a few 18 inches deep. After the tree is stood up in the hole by means of the tackle and screws, earth is packed under the center by packing-sticks. This is difficult and there are liable to be air-holes left vacant. A stream from a hose will help to wash mud into these spaces. It is best to leave the bundles of side roots tied up while this is going on. Before the bundles of side roots are untied, the bottom of the hole should be filled up, if necessary, so that these are 2 to 8 inches below the surface. Spread out the side roots and cover with earth.



330. The roots wrapped, and the tree being moved on skids.

Anchoring the tree is important. It is easily done by three or four anchor posts 4 feet deep with a crosspiece 3 feet long. Wires should be put through rubber hose and twisted around the tree. The tree is liable to settle, the anchor posts move, the tree lean and require straightening and tightening of the wires by further twisting.

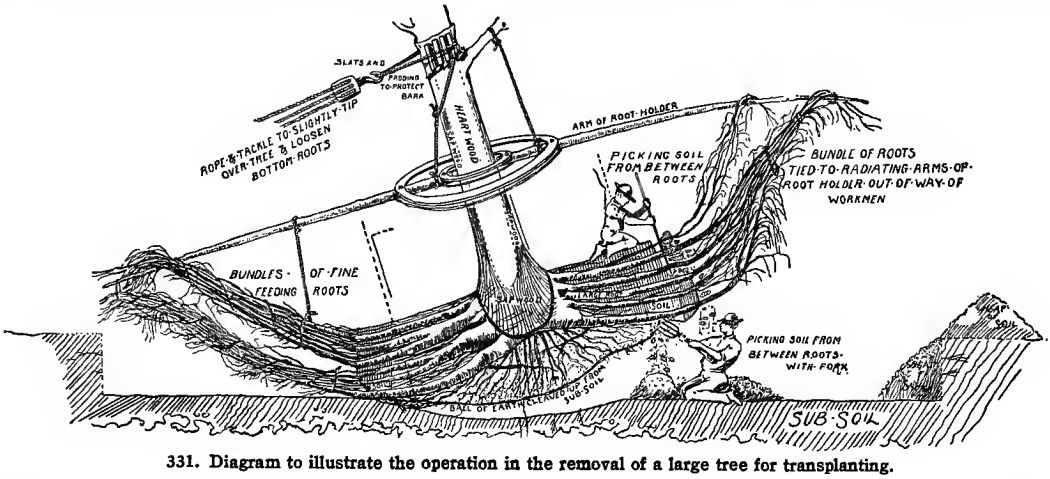
Pruning is important, made so by cutting back the tree from 2 to 8 feet all around. It is best to cut the most at the apex and the least at the sides, to make the shade as wide as possible. If cut back to an even outline, the tree will make a dense growth and look more solid the first year. If the thinning-out method is used, the thinning is liable to be too great in the center of the tree, as it is easy to reach, and the tree has to thicken up over a period of four years by making sprouts in the center, the outer branches remaining thin, especially if the tree is not fed and watered enough.

Wrapping the trunk with straw may be necessary with thin-barked trees, especially in warm and dry climates. The bark is liable to dry out and die on the southwest side. The wrapping and anchors may be removed after two years or more.

A mistake is often made in choosing trees within two miles, whereas, the area to draw upon is over fifteen or twenty miles radius which will contain much better trees, the time on the road being a comparatively small item in the total cost. Trees are often chosen which are growing on thin or rocky soil or in swamps saturated within 6 inches of the surface, both giving much less amount of roots than trees in a friable soil 3 feet deep. In a country of hills and valleys, the best trees may often be found in terraces or benches above the river bottom or in the river bottom if drained to allow roots to be 3 feet deep. Trees are often chosen which are too old and have made a short, slow growth. It is better to move a young tree 35 feet high, 12 inches in diameter, which is growing 1 foot a year, than to take a tree the same size, twice as old, growing 3 inches a year. The roots on the latter will be longer and less flexible. Each will live and grow rapidly if given favorable conditions. A mistake is often made in choosing trees which are crowded or in thick forests. The latter may appear to have low branches. These branches are weak and liable to die. Trees of species difficult to move and trees about the moving of which little is known are liable to be chosen. Trees which move readily are those of soft wood, rapid growth, usually native in moist soils, as maple, elm, linden, poplar, locust, catalpa, horse-chestnut, birch, apple and pin oak. The following are trees about which less is known: Pepperidge, sassafras, plane, chestnut, beech, tulip, white oak, black oak, liquidambar, ailanthus, hickory, walnut and ash. The chestnut, beech, magnolia, tulip tree, black oak and walnut do not indicate by their behavior when small that they are readily moved. It is to be presumed that the ailanthus and ash are easily moved. No species has proved itself impossible to move. It is merely a matter of getting the right proportion of roots and top and nursing the tree through the convalescence until it has reëstablished itself. In moving trees it may be better to move three

trees 8 inches in diameter, 35 feet high, than one tree 16 inches in diameter, 35 feet high. From three smaller trees there will result a wider mass of foliage, and it will be easier for those not equipped with large tree-moving apparatus to handle the three smaller trees.

If the earth is dissected out from the roots, two trees 8 inches in diameter could be carried by one team. They can be loaded on a low stone truck or handy wagon, the trunks of the trees resting on two benches which lessens the breakage of roots and top. Trees can be loaded by the men, the tree being tipped over on the truck which stands beside the hole.



331. Diagram to illustrate the operation in the removal of a large tree for transplanting.

The tree is shifted into position by the men lifting on the trunk, or it may be lifted by a shear pole derrick or single pole. Many people hesitate about moving large trees and wait fifteen years for a result they could easily secure in this manner, by collecting wild trees in the vicinity.

Root-pruning a year in advance may aid in moving a tree, but is not essential. If a trench is to be dug at a radius of 4 feet all the way around a tree 10 inches in diameter, it is better to move the tree with a wider spread of roots and take good care of it. A root-pruned tree is likely to be neglected and suffer for moisture. The tree can be root-pruned three-quarters of the way around for one season and perhaps be in better condition for moving. This is more likely to be beneficial with a tree with long coarse roots and with few fibers in the center, like a black oak. A mistake is frequently made in assuming that a ball of earth is all that is essential, regardless of the amount of fibrous roots in the ball and of its area to gather rainfall as compared with the top. Frequently trees dug around the roots cut off at a diameter of 10 feet, have the tree-mover sent for when they should have a spread of roots of 30 feet. The ball-of-earth method with deciduous trees usually consists in carrying a ball of earth 7 to 9 feet in diameter with trees 10 to 18 inches, on a low truck consisting of a platform hung under four heavy wheels, the tree being lashed fast to a collar and pole on the rear axle, and pulled over to the rear and then the platform chained fast to the rear axle. The roots outside the ball are usually cut off. With elm trees carrying a slender top this method succeeds, although the trees are often slow in recovering. It succeeds with maples, but they are likely to grow slowly or die back until the tree reëstablishes a balance, after several years.

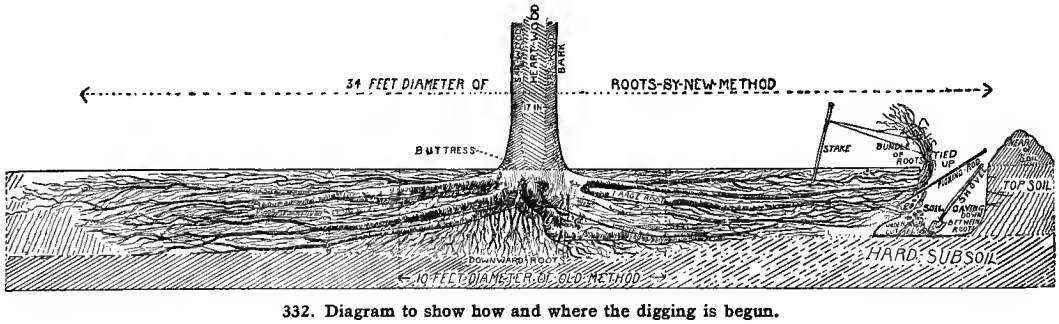
Deciduous trees can be moved in midsummer in full leaf. Norway maples 7 inches in diameter were well watered to fill them with sap; the next day they were dug with roots spreading 15 feet, leaving a ball of earth 5 feet in diameter in the center. The tree was tipped back and a platform or stone boat moved under, on which it was moved. After planting the trees were watered about four times, once in ten days. The ball of earth became dry very quickly. The bundles of outer roots did not send out fibers for about two weeks. Trees with less fibers in the center would probably not succeed so well. See also *Drainage* and *Evergreens* for further discussion.

HENRY HICKS.

Types of insect injury to trees.

Trees of all sorts are liable to injury by many kinds of insects, so many indeed that it is difficult to present a satisfactory account of their depredations without going into great detail. A few insects stand out preëminently, however, among the more common and widespread tree pests and a selected series of these will serve as examples of the various ways in which the trees may be injured by these animals.

Destructive forest- or shade-tree insects may be grouped into two classes, according to the way in which



332. Diagram to show how and where the digging is begun.

they feed, based on the fact that one series feed by chewing and consuming the tissue of the trees, while the members of the other class derive their nourishment from the juices or sap of the trees which they suck out by means of needle-like sucking mouthparts. Most insects pass through three, or at least two, preparatory stages, very different from the adult, before they reach maturity. They hatch from eggs deposited by the adult female, as larvæ (grubs, caterpillars, maggots, and so on) and in this larval stage feed till they attain their full size. The larval stage is, therefore, the most destructive one. When full grown, the larva usually changes to a resting condition or pupal stage (chrysalis), and during this time does not feed. Finally the adult appears and the life-cycle is complete. Many insects undergo a single generation every year, but a number grow more rapidly, producing several broods each season, while a few require two years or more to mature.

333. Lepidopterous caterpillar. (×¾)

Insects provided with chewing mouthparts may feed on the leaves and are then known as defoliators; or they may feed on the bark, cambium, sapwood, heartwood, or roots, in which case they are known as borers. Caterpillars, beetle grubs and saw-fly larvæ are the most important insects of the latter kind.

Among the insects with piercing mouthparts, some suck the juices of leaves, while others affect the twigs and branches, or even the roots. Plant-lice and scale insects are the most important insects of this kind.

Methods of destroying tree-pests.

There are five widely different methods of destroying insects which injure trees, and the selection of an appropriate method must depend primarily on the feeding-habits of the species to be dealt with.

(*a*) *All defoliators*, such as caterpillars (Fig. 333), saw-fly larvæ (Fig. 334), and those beetle larvæ that feed externally upon the leaves, are best killed by the application of an arsenical poison (Figs. 335, 336). This is applied preferably by some sort of a spray-pump that throws a fine mist or spray of water in which the arsenical has been mixed. Such spraying machines may be obtained in sizes to suit any needs, from hand-pumps holding a quart of liquid to power sprayers equipped for spraying extensive woodlands thoroughly and rapidly. The most satisfactory poison is arsenate of lead, an insoluble arsenical which can be mixed with water in the proportion of six to ten pounds to each 100 gallons of water and sprayed upon foliage without danger of damage to the leaves. It is sold commercially as a white paste and is easily handled. This substance is far superior to paris green, london purple, and the like. It should be applied only in sufficient amount to show after drying as whitish specks upon the surface of the leaves.

334. Sawfly caterpillar. (Natural size.)

(*b*) *Plant-lice*, since they feed by inserting their beaks into the tissues of the leaves, and other soft parts, are not affected by arsenicals and must be destroyed by spraying with what is known as a contact insecticide, one that kills through the application upon the surface of the insect's body. The most generally used, and one of the best contact insecticides is kerosene emulsion. This is prepared by dissolving half a pound of common laundry soap in one gallon of hot water and then adding two gallons of kerosene while stirring or churning the mixture violently. The creamy mass thus formed thickens on cooling and must be diluted with nine times its volume of water before being sprayed upon the plants. Scale insects feed like plant-lice, by inserting their delicate beaks into the tissue of the tree and sucking out the sap, but usually occur on the thin bark of the branches and twigs rather than on the leaves. Each insect secretes a scale-like covering beneath which it lives while growing, and, even when adult, the female never leaves her position beneath the scale. As the scaly covering is of a waxen nature, these insects are not so easily destroyed by contact insecticides as are plant-lice, although kerosene emulsion is sometimes effective, especially in the case of young insects which have not yet secreted a thick scale. Many older or more resistant scales cannot be destroyed in this way and they may be killed when the trees are in a dormant condition by a spraying with lime-sulfur wash prepared as follows: Water, forty gallons; fresh lime, twenty pounds; flowers of sulfur, fourteen pounds. These are boiled together for one hour and then applied as a spray to the branches and twigs. This wash should never be sprayed upon trees when in leaf.

335. Injury by leaf-eating caterpillar of small size.

(*c*) *Bark-beetles.*—These are small insects that live during the larval stages beneath the bark of the trunk and branches of trees. The parent insects enter the bark and excavate a small tubular gallery through the cambium or inner bark. Along the sides of this, the eggs are laid and the developing larvæ eat out sinuous burrows through the cambium. They thus interfere with the sap-flow and cause a general weaking or even death of the tree. Bark-beetles are liable to attack sickly or dying trees, and the only feasible method of lessening their depredations is to remove and burn such trees or branches as are affected, in addition to improving in all possible ways the conditions under which the tree is growing, bearing in mind that healthy trees are much less likely to be troubled by these insects than are weak, poorly nourished ones.

(*d*) *Wood-borers.*—The larvæ of certain beetles and moths subsist upon the woody tissues of trees, excavating galleries through the wood of both living and dead trees. Such larvæ are usually whitish, often with brown head and have powerful jaws, by means of which they can cut through the solid wood. They may attack trunk, branches, or twigs, some working in the sapwood, others in pith, while a few feed mainly on the heartwood. Insects of this kind are the most difficult to combat as they feed where they cannot be reached by means of insecticides during the greater part of their life. Due to their concealed position, they are not so readily noticed and may frequently cause irreparable damage to trees before their presence is recognized. Besides cutting out the individual larvæ or destroying them in their burrows by means of a piece of wire, no general method of destruction can be recommended. It is important, however, to maintain the trees in as healthy condition as possible, and to remove all dead or dying timber in order to reduce the number of breeding-places for the insects.

336. Injury by leaf-eating caterpillar of large size.

(*e*) *Leaf-miners.*—To this class belong some of the

members of several different groups of insects, certain small moths, a few saw-flies and a small number of flies and beetles. All of the leaf-miners are very small insects whose larvæ feed upon the parenchyma of the leaf, leaving intact the upper and lower epidermis. In this position they are protected from most sorts of insecticides, although in some cases, spraying with a contact insecticide containing some tobacco compound in combination with soap may be efficacious. One formula recommended is: water, 800 gallons; nicofume, or "blackleaf 40," one gallon; laundry soap, thirty-two pounds. Ordinarily, leaf-miners do not present a serious menace to trees, but the presence of their blotch-like or serpentine galleries, which show as faded areas, often greatly disfigure the leaves.

337. Tussock moth larva. (× ½)

Some of the more important shade-tree pests.

A. *Defoliators.*

The tussock moth, *Hemerocampa leucostigma* (Fig. 337), is perhaps the most abundant caterpillar on trees, particularly in thickly settled districts. The eggs are laid in the fall in white fluffy masses the size of a dime on the trunks of infested trees and hatch in the early summer. The larvæ bear several pencils of long black hairs placed at each end and have four brush-like tufts of pale yellow hairs above, with a bright red head. These pupate early in July in crevices in the bark and the adults soon emerge to lay the eggs for a second generation of caterpillars which will mature before fall into moths that deposit the over-wintering eggs. The female moth is without wings and lays her mass of eggs on the bark where she emerges from her pupa case. These caterpillars feed on all sorts of trees except evergreens, but seem to be most destructive to maple, elm and American linden. Two related caterpillars have been imported from Europe into Massachusetts, the gypsy moth and brown-tail moth, and although these are at present confined to that neighborhood, they will undoubtedly become widespread before many years have elapsed. The gipsy caterpillars feed on many kinds of trees, preferring oaks; they may be recognized by a double line of round spots down the middle of the back, blue, followed by red ones. Their life-cycle is like that of the tussock moth, except that there is only one generation passing the winter as a mass of woolly, dull ochre-yellow eggs attached to the bark. The brown-tail is a brownish caterpillar with white spots, passing the winter in small woven silk nests containing many caterpillars. The nests are attached to the tips of the twigs of infested trees. Orchard trees suffer most severely from this species, although all sorts of broad-leaved trees are attacked.

338. Cocoon of bag-worm. (× ½)

Another common caterpillar of very different habits is the American tent-caterpillar, *Malacosoma americana*. This is an inconspicuous brownish moth which over-winters as a band-like mass of eggs placed around twigs of cherry and a number of other trees. These hatch in very early spring and the larvæ spin silken nests in small forks of the branches from which they crawl out to feed upon the opening leaves. They mature in early summer and the eggs are laid in midsummer for the next season's brood.

The bag-worm, *Thyridopterix ephemeræformis*, is a defoliator, at times very destructive, although each larva in his dependent bag does not have a wide range of operations. Fig. 338. Hand-picking and arsenical sprays are the remedies.

The caterpillars of the mourning cloak, *Euvanessa antiopa* (Fig. 339), are a very common pest of elm and other shade trees. They are black, coarsely spiny caterpillars with red spots along the back, and feed more or less in colonies, usually defoliating single branches at a time. The butterfly passes the winter as an adult, appearing in very early spring, and laying its eggs in May. The caterpillars from these eggs become full-grown before July, and the butterflies of another generation appear in July to lay eggs which will give rise to the hibernating butterflies of the next winter.

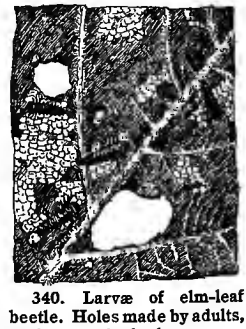
339. Euvanessa antiopa. (× ½)

A common saw-fly which occurs on willows is the American saw-fly, *Cimbex americana*. The larvæ are much like the defoliating caterpillars of moths and butterflies in appearance and feed in the same way, destroying the entire leaf-tissue. The larvæ are pale green, with a blackish line down the back. When mature, they descend to the base of the tree, where they spin parchment-like brown cocoons in which to pass the winter on the ground among fallen leaves. In the spring, they transform and the adult saw-flies deposit their eggs singly in slit-like cuts made into the tissue of the leaf.

Pine trees often suffer from the depredations of saw-fly larvæ of the genus Lophyrus which devour the needles, near the bases of which they later spin their small cocoons.

Many saw-fly larvæ feed only on the leaf from one side, leaving the epidermis of the other side intact. Arsenical sprays for the destruction of such species must be directed against the side of the leaves attacked, usually the under surface.

Among defoliating beetle larvæ, the imported elm-leaf beetle, *Galerucella luteola* (Fig. 340), is probably most important. This occurs only in the eastern states but is gradually spreading into the middle West. The small, yellow, two-striped adults live through the winter and deposit their bright yellow eggs in small masses on the under side of elm leaves in early spring. These eggs hatch into black and reddish slugs which feed on the under surface of the leaves, leaving only the veins and upper epidermis. The leaves then dry up and may fall off. The larvæ, now changed to a yellow color, descend to the surface of the ground to pupate and soon emerge as a summer generation of beetles. There are two or three annual broods, according to the latitude.



340. Larvæ of elm-leaf beetle. Holes made by adults, surface marks by larvæ.

B. *Plant-lice and scale insects.*

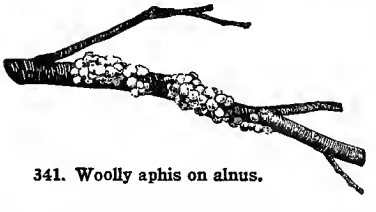
There are many kinds of plant-lice (Fig. 341), but all pass through very similar life-cycles. In general, this is as follows: the winter is passed as a large, shining, elongate-oval egg attached to a twig or branch. This gives rise in the spring to a soft-bodied wingless female aphid that gives birth to living young aphids, which in turn reproduce in the same way. These suck the juices from leaves, petioles or tender twigs and thus sap the vital-

ity of the tree. In addition, the leaves may be disfigured by a sticky substance, known as honey-dew, secreted by the insects. In the fall, both females and winged males are produced and the female lays a single winter egg. On account of their method of reproduction, plant-lice multiply very rapidly, especially in damp seasons. Some species have a more complicated life-cycle, producing winged individuals in the summer which migrate to another food-plant, later to return in the fall to the original one.

A few plant-lice living in colonies produce galls, curled leaves, or other malformations on the leaves or twigs of infested trees.

Scale insects exhibit a greater variety in their seasonal history; some pass through a single generation each year, while others multiply more rapidly, passing through a number of generations annually. The winter is sometimes passed in the egg state, but more commonly as a partly grown insect.

One of the commonest and most destructive scales is the oyster-shell scale, *Lepidosaphes ulmi*. This occurs on the thin bark of a great variety of trees, appearing as a very small, elongate, flattened body, pointed at one end and rounded at the other, with the upper surface more or less distinctly ridged in a transverse direction.



341. Woolly aphis on alnus.

There is a single generation annually, the females maturing in late summer and depositing a mass of eggs which remains beneath the scale through the winter, hatching in the spring and producing full-grown insects by midsummer. Sometimes this species is so abundant that the smaller branches appear as if covered by a gray incrustation.

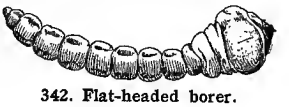
The San José scale, *Aspidiotus perniciosus*, is another important scale, which has been introduced into many parts of the United States. It is very destructive, primarily to certain orchard trees, but injures many thin-barked shade trees as well. The scale is very small, round in the female and oval in the male, with a minute nipple-shaped projection near its center. The females do not lay their eggs till the young insects are ready to hatch, so that they practically produce living young. These develop rapidly, five or six broods maturing each season, of which the last hibernates in the half-grown condition. In mass, the scales form a gray, granular crust, covering the branches and twigs.

In some parts of the country, maples grown for shade trees suffer great injury by the cottony maple scale, *Pulvinaria innumerabilis*. This scale is most conspicuous on the twigs in early summer, at which time the females are depositing their eggs. It then bears a tuft of fluffy waxen substance resembling a bit of white cotton. The young scales appear soon after, when they migrate to the leaves and feed till early fall before returning to the twigs, where they finally pass the winter in a half-grown condition.

Practically all sorts of trees suffer at times from scale insects, of which there are many kinds. The common forms are divisible into two groups, the soft scales and armored scales. The former are soft and convex like the cottony maple scale, in which the "scale" is the back of the insect itself; the latter are usually smaller, like the San José scale, in which the "scale" is a separate waxen cover secreted by the insect.

c. *Bark-beetles.*

These insects are small black or brown beetles that live in the larval stages beneath the bark, feeding on the inner bark and cambium, and all have very similar habits. The parent beetle enters the bark through a small hole about the size of a pencil-lead, and excavates a single primary or egg-gallery through the cambium, usually grooving the sapwood. This tunnel varies from one to several inches in length, and along its sides the female cuts out little pockets, in each of which an egg is laid. On hatching from the eggs, the larvæ excavate individual mines usually more or less perpendicular to the egg-gallery. When full grown, the white legless grub-like larvæ pupate in cells excavated in the bark, from which the beetles emerge by chewing out a circular tunnel to the surface. Trees from which beetles have emerged appear as though the bark had received a charge of buck-shot, from the presence of the small circular emergence holes. Some forms, like the genus Denroctonus, attack fine healthy coniferous trees and kill much valuable timber, but shade trees are more commonly attacked by the species that live in the bark of deciduous trees, more particularly those that are in a sickly condition.



342. Flat-headed borer. (Natural size.)

A common form is the hickory bark-beetle, *Eccoptogaster quadrispinosa*, that attacks hickories. The beetles appear in June and July, to excavate the primary galleries which extend vertically for an inch or two. Forty or fifty eggs are placed in notches on the sides and the larvæ bore out at right angles, thus girdling the cambium and weakening or killing the branch. This species undergoes only one generation annually, although some others pass through two or more each season. There are many other kinds, all scarring the bark or surface of the wood in a similar way.

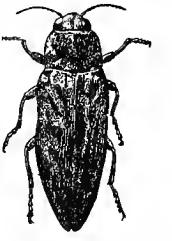
d. *Wood-borers.*

The larvæ of many beetles and moths, and of a few wasp-like insects, injure trees by excavating their food-burrows through the solid wood.

Birches, grown for shade or ornamental trees, often suffer great injury from the presence of a flat-headed borer, the bronze birch-borer, *Agrilus anxius*. The small elongate bronze-green beetles appear in May or June and deposit their eggs on the branches, at first near the crown of the tree. The larvæ penetrate the bark, beneath which they cut irregular flattened galleries till grown, when they cut out cells in the wood in which to pass the winter before emerging in the spring. The upper parts of the tree suffer first and begin to die, and the following year the larvæ appear nearer to the ground. Chestnut is attacked by *Agrilus bilineatus*, the two-lined chestnut-borer.

Most other kinds of trees suffer similar injury from related beetles, many of which multiply also in dead trees and stumps.

Another flat-headed borer, the larger flat-headed pine-borer, *Chalcophora virginiensis* (Figs. 342, 343), extends its flattened burrows deep into the wood of the tree, a method of feeding exhibited by many borers of this group attacking deciduous trees also. The larvæ grow to a length of 2 inches before cutting out their transformation cells in the bark.



343. Chalcophora virginiensis, adult of flat-headed borer. (Natural size.)

Round-headed borers are similar in habits, but belong to another family of beetles in which the larvæ are less distinctly flattened near the head and excavate more nearly cylindrical burrows.

One of our commonest species is the locust-borer, *Cyllene robiniæ*, which attacks yellow locust trees. The elongate medium-sized black beetles, with brilliant yellow markings, appear in the early fall to deposit

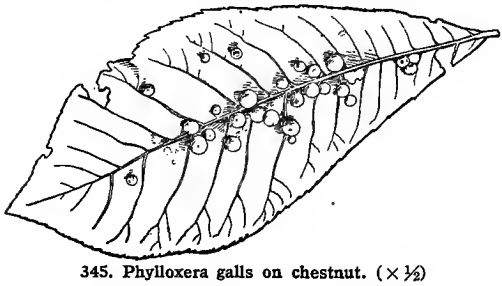
their eggs on the bark of the trees. The eggs soon hatch into larvæ which feed for a time and then over-winter in a small cell beneath the bark. Next year they bore through the living wood and transform in August to beetles. This species can destroy healthy locust trees rapidly and is a very serious pest wherever the tree is grown. All infested trees should be pruned or felled and burned to destroy the larvæ, in the fall or winter. Sugar maples suffer from a similar insect, as do practically all sorts of trees.

344. Injury to tip of white pine sapling by white-pine weevil. (×⅛)

White pine trees are commonly deformed by the larvæ of the white-pine weevil which feed exclusively beneath the bark of the terminal shoots of young trees of this species. (Fig. 344.)

The carpenter moth, *Prionoxystus robiniæ*, is a large common mottled gray insect with pale yellow black-headed and black-speckled larvæ 2 inches in length, that bore in the branches of many kinds of trees. Oak suffers most, but maple, ash, locust, willow and cottonwood are often infested. The moth lays its eggs on the bark late in the summer, and for two or three seasons the larvæ feed on the wood, cutting large circular burrows. They transform in the burrow, the pupa working its way partly through the bark for the eclosion of the moth. The brown pupa-case may then remain projecting from the mouth of the burrow for some time. A related European insect, the leopard moth, *Zeuzera pyrina*, has recently become abundant along the northern Atlantic coast region, attacking elm and all sorts of other trees and shrubs. It feeds in the same way and bids fair to become one of our worst shade-tree pests. The larvæ of many other moths injure trees in a more or less similar way.

The pigeon horn-tail is a large cylindrical yellow-brown and black insect with grub-like larvæ that bore



345. Phylloxera galls on chestnut. (× ½)

in elm, maple, and other trees. The females insert their eggs deep into the tree by means of a needle-like ovipositor. They frequently fail to extricate the ovipositor and may be seen dead, but still attached to the tree trunks.

E. *Leaf-miners.*

Small larvæ belonging to several orders of insects live as miners in leaves, the most abundant forms often greatly disfiguring the foliage of affected trees.

Deciduous trees of all sorts are affected by the leaf-mining larvæ of various small moths, but it is very difficult to distinguish the different species without minute study. Oaks are particularly susceptible and are commonly disfigured by the sinuous or irregularly rounded mines that appear as pale streaks or blotches. Even pines suffer from such larvæ, which enter a needle and eat out the tissue, causing the tip to dry and become yellow. Occasionally insect larvæ cause malformations

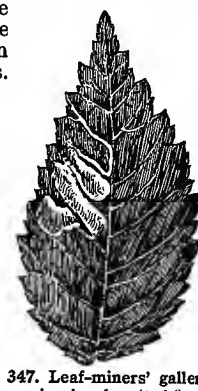
or swellings of the leaves or twigs, known as galls. (Figs. 345, 346.)

Yellow locust suffers from a leaf-mining beetle larva, *Odontota dorsalis*, that eats out almost all of the leaf parenchyma, causing the leaves to dry and shrivel. Related species affect oak and basswood. Members of another family, belonging to the genus Brachys, also mine in leaves of oak, chestnut, and so forth.

One leaf-mining saw-fly is of considerable importance, *Kaliofenusa ulmi*, the larvæ of which eat out the parenchyma of elm leaves between the lateral veins, causing them to assume a seared appearance in spots (Fig. 347). Another closely related species mines in the leaves of the hawthorn (Cratægus). The latter may be satisfactorily killed by a spray of tobacco-water, but the species on elm is more resistant. The larvæ of these species enter the ground later in the summer to spin their cocoons.

C. T. Brues.

346. Mite-galls on maple. (× ½)



347. Leaf-miners' galleries in elm. (× ½)

Some types of tree diseases.

Disease in plants is the result of any derangement in the normal form, structure or physiology of the organism. The disease condition becomes manifest by different symptoms, according to the nature of the disorder. Such symptoms as stag-head, cankers, leaf-spots, witches' brooms, and so on, are examples of the effect produced in the tree by some disease-producing agent or combination of agents. The variety of functional disorders alone that may arise in trees is large. Such causes as insufficient or excessive soil water, malnutrition, excessive heat or cold, or rapid variations in temperature are capable of producing effects called physiological diseases. On the other hand are those diseases that are produced by the activities of parasites, such as certain of the fungi, and bacteria. Accurately to place a new or little-known disease in one of these two classes is often difficult for the expert, even after much study. There is relatively less known concerning the physiological diseases of trees than of those caused by parasites, not because of their less importance so much as of the difficulty of studying them. It is to be deplored that the diseases of forest, shade and ornamental trees have not received their due share of study and investigation by pathologists.

How fungi cause diseases of trees.

The fungi consist of a group of plants that do not contain chlorophyll, upon which all green plants depend for the synthesis of carbohydrates. Consequently, not being able to manufacture their own food, the fungi must secure it from their environment, by dissolving and utilizing organic materials from dead or living plant or animal bodies. By far the vast majority, luckily, belong to the class of scavengers which attack dead organic material and utilize it for food. These forms are called saprophytes. Other species of the fungi attack living plants and, through their activities, produce the disorders that are termed diseases. These are known as parasites or pathogens.

In brief, the general action of the fungi that cause tree diseases is as follows: The fungus exists in two stages, the vegetative and the fruiting. The vegetative stage consists of a mycelium, which is an aggregate of long much-branched microscopic threads of fungous cells. This mycelium penetrates and grows in the body of the tree, extracting nutriment from it by dissolving the different structures it can utilize. In this process the tissues of the tree are destroyed and the fungus obtains food for its further development. In time, after sufficient food has been stored in the mycelium, the fungus forms its fruiting bodies. In the case of the larger number of the heart- and sap-wood rots, this fruit body consists of a shelf-like or toadstool-like structure on the exterior of the tree. In these fruiting structures are borne millions of microscopic spores or seeds of the fungus, which are distributed largely by the wind. If by chance one of these spores finds lodgment on an exposed wound in the bark of a tree which it is capable of infecting, it will under proper conditions germinate, producing a mycelium that will penetrate the tissues of the new host.

Seedling diseases.

The young seedlings in the nursery beds are often attacked by certain soil organisms that cause a decay of the stem at the surface of the ground, allowing the plant to wilt and fall over. This type of disease is called "damping off;" in many cases it is caused by the fungus *Pythium de Baryanum*. This disease is largely induced by very moist soils, a moist atmosphere, high temperature, and little ventilation. By growing seedlings in light sandy soils, well watered but not excessively, and by aërating the beds well to reduce the humidity of the atmosphere around the plants, this trouble is practically avoided. Soils in which it has once occurred should be abandoned, however. In greenhouses in which this disease is often troublesome and the precautionary measures mentioned above difficult to maintain it may be necessary to sterilize the soil with formaldehyde or by steam heat immediately before sowing the seed.

Leaf diseases.

Very little serious damage is caused by most leaf diseases of trees other than the unsightly appearance produced. There are a few leaf diseases, however, that are of more or less importance in the United States. Conspicuous among these is the anthracnose disease of oak and sycamore leaves, caused by the fungus *Gnomonia veneta*. Throughout northeastern United States in recent years the plane-tree (*Platanus occidentalis*) has been almost universally affected and the trees often completely defoliated before the first of July. Early in the season the disease becomes manifest by the production of rapidly enlarging brown blotches which are usually produced along the veins of the leaf. If examined closely, the numerous spore clusters can be seen. These clusters are composed of innumerable microscopic conidia which serve for the dissemination of the fungus. The twigs are commonly affected also and on these, as well as the fallen leaves, the fungus winters over. The same fungus produces a similar disease on oaks, especially the white oak, and is often epidemic in certain regions. As a measure of prevention, all fallen leaves and twigs from diseased trees should be carefully collected and burned. All diseased twigs should be pruned off and burned. If desirable, the trees may be sprayed with standard bordeaux mixture from the time the leaves begin to unfold, at periods of two or three weeks, until the first of July.

348. Maple leaf affected by the tar-spot fungus, Rhytisma acerinum.

The tar-spot disease of the maple caused by *Rhytisma acerinum* is a conspicuous disease but seldom causes serious damage to the tree. Fig. 348. The diseased spots appear as blotches of tar on the upper surface of the leaves. Burning the diseased leaves will materially lessen the chances of attack the coming year since the pathogen winters in them.

Maple trees, at least in the northeastern states, have suffered during the past few summers from a physiological trouble called leaf-scorch. The leaves of one side or the whole of the tree turn brown between the veins and finally dry up. This disease has been ascribed to over-transpiration of the leaf-tissues at a time of year when the roots cannot furnish enough water to the tree to compensate the loss. Thus the leaf-cells are killed by desiccation and the brown blotches appear. It is advised that artificial watering during hot, dry weather will materially lessen the severity of the trouble, especially under city conditions.

Canker diseases.

A diseased condition of the limbs or trunk of a tree that results in the death of an area of the bark is termed a canker. These cankered areas may be either sunken or enlarged, and the terms necrotic and hypertrophy cankers are used respectively to designate these characters. Not all cankers are produced by parasitic organisms; some are the result of malnutrition, winter injury, sun-scorch, insects, and the like.

349. Canker disease of the chestnut produced by the fungus, Endothia parasitica. The conidial tendrils are produced from the numerous ruptures shown in the bark.

By far the worst epidemic disease of trees in America is the chestnut-canker now prevalent in many of the eastern states. In all, a total loss of $25,000,000 has been ascribed to this disease between the time it was first noticed, in 1904, on Long Island, and the year 1912. The cankers produced on the chestnut are caused by the fungus *Endothia parasitica*. Fig. 349. At present, the question of the origin of this disease in the United States is undetermined. The fungus works rapidly in the bark and sap-wood, killing the tissues. Fruiting bodies of two types are formed on the diseased bark, a conidial stage that appears as long yellow tendrils of gelatinous matter and the reddish yellow to dark brown cushion-like stromata that contain the ascospores. These latter spores are ejected in large numbers at every rainy period throughout the spring, summer, and fall and are carried by the wind, readily causing new infections. On the individual tree, the fungus is rapidly spread by the washing down of the conidia into wounds in the bark. The cankered areas soon cause the death of the parts above by girdling the limb and, in most cases, complete death of the tree follows in two or three years. The state of Pennsylvania has taken steps to eradicate this disease by seeking out diseased trees and compelling owners to cut all affected trees in the western half of the state. The extremely virulent nature of the disease, however, has led more conservative pathologists to question the advisability of expending large sums of money with so slight a chance of ultimate or complete success. The

problem of saving individual trees in affected regions has not been solved. The very nature of the disease precludes spraying, and tree surgery methods have not given anything more than temporary success. Incipient cankers are so difficult to locate and, by producing conidia when only three or four weeks old, serve to spread the fungus so rapidly over the tree that human efforts so far have failed.

350. Stem of white pine tree attacked by the white pine blister-rust fungus, Cronartium ribicola. The fruiting stage is here shown in the process of rupturing the bark.

Rust diseases.

The most destructive and important rust diseases of trees are those caused by different species of the Peridermiums on coniferous trees. These rust fungi attack the needles, twigs, or limbs of coniferous trees, often producing defoliation or complete death of the tree. Notable among these diseases is the white-pine blister-rust caused by the Peridermium stage of the fungus *Cronartium ribicola* (Fig. 350) which has its Cronartium stage on species of currants and gooseberries. The fungus is not native to this country but has recently been imported from Europe. In Europe the disease has practically exterminated the white pine (*Pinus Strobus*) in many localities, and in this country the danger of a similar destruction of this species is now being faced, if the fungus acts with the same virulence as in its native environment. In 1912 the Federal Board of Horticulture placed a quarantine on most of the countries of Europe, which prevents anyone bringing white pine trees from these countries into the United States. The fungus attacks white pine from one to twenty years old, the mycelium growing in the bark and usually producing a swelling. The orange-yellow fruiting bodies burst through the bark in one to five years after infection. The spores from the pine can affect the gooseberry or currant leaves only. On these hosts other kinds of spores are borne in the fall which can infect the white pine only and thus the yearly cycle is completed. The black currant (*Ribes nigrum*) is by far the most virulently affected in this country, and it is advised that plants of this species are therefore extremely dangerous to the white pine industry and their culture should be discouraged. By keeping currants and gooseberries at least 500 feet away from white pines, a partial safeguard is provided against the passing of the fungus from one host to the other. All plants affected by this fungus should be immediately destroyed. Consult Bureau of Plant Industry, U. S. Dept. of Agric., Bulletin 206 for further details.

351. Black spruce attacked by the dwarf mistletoe, Arceuthobium pusillum, causing witches' brooms.

Witches' broom diseases.

Excessive branching at any point on a limb, forming a compact cluster of short stubby branches, is often caused by numerous agents, both insect and fungus, as well as by the mistletoes. In the South, especially, trees of many species are disfigured by these witches' brooms caused by the American mistletoe, *Phoradendron flavescens* and related forms. In the northern states the dwarf mistletoe, *Arceuthobium pusillum* (Fig. 351) causes similar brooms on the black spruce (*Picea Mariana*). Witches' brooms on red cedar (*Juniperus virginiana*) are caused by the rust *Gymnosporangium nidus-avis*.

Root diseases.

The principal root disease of trees that is widely distributed throughout the United States is that caused by the mushroom *Armillaria mellea*. Fig. 352. The mycelium of this fungus grows in the soil on decaying wood as a saprophyte, but can also become parasitic, killing trees over large areas. Almost any of our indigenous trees may be affected with this disease. Fruit trees often suffer in certain regions. The mycelium penetrates the roots and grows in the bark and wood, working up into the base of the tree. The destruction of the root-system is so rapid, however, that two or three years after infection the tree often dies, before the fungus has spread any great distance up the trunk. In the older decayed parts of the root and in the soil, the mycelium is aggregated into long black, flattened strands called "rhizomorphs," or more commonly termed, "shoe-strings." In the case of coniferous trees, an abundant exudate of resinous sap occurs at the base of affected trees, which forms the surrounding soil into a cake. The disease may be recognized by the gradual yellowing of the foliage, decay of the roots, presence of the "shoe-strings" in the soil, and the appearance of the honey-yellow mushrooms around the base of the tree. No practical method of treatment is known. Diseased trees and the mushrooms should be destroyed.

352. Base of young white pine tree attacked by Armillaria mellea. Note the cake of earth around the tree due to the exudate of resin, also the white mycelium felts within the bark and the enlarged resin vesicles induced by the fungus. The slender strands clinging to the cake of earth are the "shoe strings."

Other soil organisms may enter through wounds in roots and cause diseases. Such a disease may, after becoming established in the roots, continue to spread up the trunk. Thus wounded root-systems are as dangerous a source of infection as wounded branches. Roots often suffer from winter injury largely because the wood ripens from the top of the tree downward, and when severe conditions are undergone early in the winter before the new wood of the roots has ripened, it is killed.

Heart-rot diseases.

Most of the wood-rotting fungi belong to a class known as the wound parasites. By far the most universally distributed and destructive of these is the shelf fungus, *Fomes igniarius* (Figs. 353, 354), which causes the white heart-rot of deciduous trees. Infection may occur in any part of the tree where wood is exposed. The mycelium, by dissolving the lignin of the woody elements, first causes a brown decay that is later succeeded by a whitish decomposition, at which stage very little of the original woody structures is left. This decomposition of the heartwood takes place rapidly and often the tree is blown over. The fruiting bodies of this fungus are produced usually at the point of infection. They consist of large hoof-shaped bodies, carbonaceous and rough on the upper surface, and brown beneath. The under surface is full of small holes which are the openings of long vertical tubes, on the inner surface of which the spores are borne. These spores sift out of the tubes and are distributed by the wind.

Another fungus commonly met with, and acting similarly, is *Fomes fomentarius*. This is also at times a wound parasite but works mostly in the sapwood first and later spreads into the heartwood. A yellowish white, soft decay is produced. Large sheets of a chamois-skin-like character are often found in trees rotted by this fungus. These sheets are compact masses of the mycelium which have filled up the long cracks produced by the shrinking of the diseased wood. The sporophores are essentially different from those of *F. igniarius*, being light gray and smooth on top and light gray-brown beneath, with relatively large pores. Numerous other shelf fungi occur as wound parasites and do more or less damage where the bark, when wounded, was not protected until the natural callus could form. Some of the fungi which are wound parasites of living trees continue a saprophytic life in structural timbers, causing their ultimate destruction.

Winter injury, sun-scald and drought.

Many misconceptions are prevalent concerning the real effect of freezing and sun-scald on trees. The injury by freezing in trees is due to the action of low temperature upon the water in the cells of the tree or to the tension pressures induced. As the temperature approaches freezing, the water in the cell begins to pass out into the intercellular spaces and there accumulates. The lower the temperature goes, the more water is extracted from the cell and stored in the intercellular spaces as ice crystals. When a certain temperature is reached, the amount of water withdrawn is such that the living elements of the cell can no longer survive, and are killed. This specific minimum temperature varies for different species of trees, accounting for the difference in susceptibility to winter injury. The living tissues of the tree constitute the bark and sapwood, and when areas of these tissues are killed, serious damage is done to the tree. Either enough damage is done to the roots, trunks, or twigs to cause ultimate death the coming summer, or the areas that were killed serve as infection courts for the various wound parasites like the heart-rot or sap-rot fungi. In the case of sun-scald, the action is exactly similar, with the exception that the water is removed from one side of the tree by excessive heat during the growing season, instead of by freezing. The cracking and splitting of the bark of trees may be due to the tension pressure set up in the bark by the contracting of the woody cylinder in circumference during periods of low temperature.

Norway maple trees planted for shade are especially susceptible to sun-scald because they are grown close together in the nursery to a large size and then, when planted out, they are often injured by the hot sun. Care should be taken not to attempt to grow trees farther north than their natural range, which is an indication of their ability to withstand the minimum temperatures.

Trees suffer in dry seasons from drought. Water is transpired from the leaves of a large tree, in great quantities. The hotter and dryer the atmosphere, the more water is transpired. Thus it happens that during continued droughts there is not sufficient soil-water present for the roots to supply the requisite quantity to compensate for this large loss, and the leaves are killed by dessication. Dead tops or stag-head ultimately result in cases in which such conditions continue year after year. Artificial watering in such cases will relieve this condition and largely prevent the trouble.

Excessively wet soil will also act in a similar way. Tree roots in saturated soil are unable to take up water because they are suffocated by the lack of oxygen. Hence the tops suffer as from drought.

Smoke and gas injury.

In manufacturing districts in which large quantities of smoke are produced, extensive injuries to trees as well as other vegetation often result. The injurious property of the smoke is mainly due to the sulfur

353. Sporophore of Fomes igniarius var. nigricans. Spore-bearing surface shown by the lighter color.

dioxid that it contains. This gas, when dissolved in the cell-sap of the leaf or the soil-water, produces sulfuric acid, which is poisonous to the tree.

The roots of trees are also injured by escaping sewer-gas or illuminating gas, which either poisons or suffocates the roots. Trees killed by escaping gas in the soil usually shed their outer bark in large patches near the base, the inner bark remaining tighly appressed to the tree.

Trees that come into contact with electric wires are injured in proportion to the strength of the current and the duration of the contact. Often trees are killed in cities from this cause.

Gases arising from recently laid creosoted paving-blocks or macadam bound with tar often cause defoliation of nearby trees, by the poisoning of the cell-contents of the leaves.

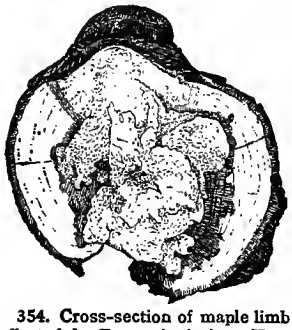
Sanitary measures for the prevention of diseases.

(1) As a first means of preventing disease in trees, one should buy clean stock from nurseries regularly inspected by state agents. Stock should be bought from nurseries in this country, owing to the great danger of importing diseases which might become epidemic. (2) In addition, one should use his influence in getting his neighbors to eradicate diseased trees and diseased parts of trees. Clean stock grown in a well-cared-for neighborhood is the problem half solved. (3) The litter of leaves or twigs under a diseased tree should be collected

each fall and carefully burned in order to prevent the wintering over of harmful fungi. (4) Care should be taken that all wounds made in pruning or by accident be immediately treated with some waterproof adhesive to prevent infection by wound parasites. In the absence of anything like accurate knowledge concerning better preparations, coal or gas tar and lead paint are to be recommended. The tar will last longer than the paint. The whole idea of wound-protection is to bridge over the time lapsing between the injury and the natural healing of the wound by the callus. Wounds previously treated should be gone over at least once a year and a new coating applied if necessary.

Prevention of leaf diseases.

Although the most of the damage done by leaf diseases is mainly to the appearance and not to the life of the tree, it may even be desirable to prevent the unsightly appearance of leaf-spot or other diseases of that nature. If, after the sanitary methods described above fail to control the disease, it is desired to spray, this can be done at some little expense if the trees are not too large. Bordeaux mixture, full strength or half strength, applied three or four times after the leaves begin to show, at intervals of about three weeks, will probably tend to lessen infection in most cases. Spray mixtures should be applied a few hours previous to general rain periods, the advance of which can be predicted by observing the government weather maps. General directions about spray mixtures and spraying machinery is now attainable from almost any one of the State Agricultural Experiment Stations.



354. Cross-section of maple limb affected by Fomes igniarius. Note that the frost crack was possibly the infection court. A young sporophore is shown just emerging at the top of the picture. (×⅔)

Treatment of diseased trees.

When the woody part of the tree is the diseased area, tree-surgery methods must be used. Badly diseased limbs and twigs should be pruned off flush. Never leave a stub. Wounds so made should immediately be coated with a waterproofing. Decayed parts of larger limbs or trunks should be carefully dug out with a gouge and mallet, being sure to remove far back on all sides of the cavity into apparently healthy wood. The growing mycelium of the fungus is advancing some distance beyond the decayed area, in what appears as healthy tissue, and must be removed to effect a stoppage of the decay. Cavities thus made may be filled with concrete or left open, provided, in either case however, that the entire surface exposed is carefully painted with a waterproofing paint or tar. Diseased roots may be treated in the same way. At the present time no method of treating diseased trees internally is known. The ideas of quacks who may advance such treatments should be doubted, for in the majority of cases such treatments will prove to be harmful. The matter of chemeotherapy for the cure of tree diseases is not without hopeful outlook, but much careful investigation by experts must be forthcoming before such methods can be evolved. W. H. RANKIN.

Choice of trees for special purposes.

The following lists include trees of proved hardiness and are not intended to be complete but merely suggestive, and chiefly for the northeastern United States and Canada.

1. TREES WITH SHOWY FLOWERS.

A. *Blooming in early spring before or with the leaves.*

Acer rubrum (fls. blood-red).
Amelanchier canadensis (fls. white).
Cercis canadensis (fls. rosy pink).
Cornus florida (fls. white, also pink).
Cornus mas (fls. yellow).
Magnolia denudata (fls. white).
Magnolia Soulangeana (fls. white to purple).
Prunus americana and other plums (fls. white).
Prunus Avium and other cherries (fls. white).
Prunus Davidiana (fls. pink, also white, the earliest of all Prunus).
Prunus pendula (fls. pinkish, branches pendulous).
Prunus Sargentii (fls. light pink).
Prunus serrulata (fls. white to pink).
Pyrus baccata and other species (fls. white to pink).
Salix (staminate plants with yellow catkins).

AA. *Blooming late in spring after the leaves.*

Æsculus Hippocastanum and other species (fls. white or red).
Catalpa speciosa (fls. white).
Cladrastis lutea (fls. white).
Cornus kousa (fls. white).
Cratægus (fls. white).
Fraxinus Ornus (fls. white).
Laburnum (fls. yellow).
Magnolia hypoleuca (fls. white).
Pterostyrax (fls. white).
Robinia (fls. white or light pink).
Syringa vulgaris (fls. white to purple).
Tamarix parviflora (pink).

AAA. *Blooming in summer and autumn.*

Aralia chinensis and A. spinosa (fls. Aug. and Sept.).
Castanea dentata (fls. white; July).
Gordonia pubescens (fls. white; Sept., Oct.).
Kœlreuteria paniculata (fls. yellow; July, Aug.).
Oxydendrum arboreum (fls. white; July, Aug.).
Rhus semialata (fls. white; Aug., Sept.).
Robinia neomexicana (fls. light pink; Aug.).
Sophora japonica (fls. white; Aug.).
Syringa japonica (fls. white; July).
Tamarix gallica (fls. pink; Aug., Sept., if severely cut back).

2. TREES WITH SHOWY FRUITS.

Acer pseudoplatanus var. erythrocarpa (fr. bright red).
Acer rubrum (fr. bright red in May and June).
Ailanthus altissima var. erythrocarpa (fr. red).
Cornus florida (fr. scarlet).
Cotinus coggygria (ample feathery panicles.)
Cratægus mollis and others (fr. scarlet or red).
Hippophaë rhamnoides (fr. yellow).
Ilex opaca (fr. red).
Magnolia hypoleuca (fr. scarlet).
Magnolia tripetala (fr. pink).
Pyrus baccata and allied species (fr. yellow or scarlet).
Rhus typhina (fr. scarlet).
Sassafras (fr. dark blue with red stems).
Sorbus americana and aucuparia (fr. red).
Taxus baccata (fr. scarlet).

3. TREES VALUED FOR FOLIAGE EFFECTS. (See also Section 5, Evergreens, next page.)

A. *With colored foliage.*

Acer Negundo var. argenteo-variegatum (the most effective of hardy variegated trees.)
Acer Negundo var. aureo-marginatum (lvs. yellow).
Acer palmatum var. atropurpureum (lvs. purple).
Acer platanoides var. Reitenbachii (lvs. becoming dark red in summer).
Acer platanoides var. Schwedleri (lvs. bright red in spring).
Acer pseudoplatanus var. Worleei (lvs. yellowish).
Betula alba var. purpurea (lvs. purple).
Fagus sylvatica var. purpurea (lvs. purple).
Populus alba var. nivea (lvs. white beneath).
Populus deltoides var. aurea (one of the best yellow-leaved trees).
Quercus pedunculata var. atropurpurea (lvs. purplish).
Quercus pedunculata var. Concordia (lvs. yellowish).
Salix alba var. argentea (lvs. silvery white).
Tilia tomentosa (lvs. white beneath).
Ulmus campestris var. argenteo-variegata (lvs. whitish).

AA. *With large, bold foliage.*

Acanthopanax ricinifolium.
Acer insigne.
Acer macrophyllum.
Aralia chinensis and A. spinosa.
Asimina triloba.
Catalpa speciosa.
Magnolia macrophylla.
Magnolia tripetala.
Paulownia tomentosa.
Quercus dentata.

X. Arboriculture.—Picea pungens, the Colorado blue spruce.

TREES VALUED FOR FOLIAGE EFFECTS, continued.

AAA. *With small, narrow, or finely cut foliage.*

Acer palmatum var. dissectum.
Acer platanoides var. Lorbergii.
Acer saccharinum var. Wieri.
Alnus glutinosa var. imperialis.
Betula pendula var. dalecarlica.
Elæagnus angustifolia.
Fagus sylvatica var. asplenifolia.
Gleditsia triacanthos.
Gymnocladus canadensis.
Hippophaë rhamnoides.
Juglans regia var. laciniata.
Quercus pedunculata var. filicifolia.
Salix nigra.
Sambucus nigra var. laciniata.
Tamarix gallica, etc.
Taxodium distichum.

4. TREES WITH BRILLIANT AUTUMNAL TINTS.

Acer rubrum (scarlet).
Acer saccharum (scarlet and orange).
Cornus florida (scarlet).
Cercidiphyllum (yellow and purple).
Cratægus (mostly scarlet and orange).
Fraxinus americana (yellow or violet-purple).
Liquidambar (scarlet).
Liriodendron (bright yellow).
Nyssa sylvatica (scarlet).
Oxydendrum arboreum.
Quercus alba (vinous purple).
Quercus coccinea, palustris (scarlet).
Rhus (mostly scarlet).
Sassafras (orange and scarlet).

5. EVERGREEN TREES.

A. *Conifers.*

Abies.
Chamæcyparis
Juniperus virginiana.
Picea.
Pinus.
Pseudotsuga.
Thuya.
Tsuga.

AA. *Broad-leaved evergreens* (only *Ilex opaca* and Rhododendron hardy in the N.).

Ilex opaca.
Magnolia glauca (not fully evergreen as far north as it is hardy).
Magnolia grandiflora.
Persea carolinensis.
Prunus caroliniana.
Prunus lusitanica.
Quercus virginiana.
Rhododendron maximum.

6. DECIDUOUS TREES VALUED FOR THEIR WINTER EFFECTS.

Acer Negundo (branches light green).
Acer pennsylvanicum (striped bark).
Betula nigra (flaky reddish brown bark).
Betula papyracea (smooth, silvery white bark).
Cratægus viridis, C. nitida and other species (red fruit).
Fagus sylvatica (keeps its dead leaves).
Gleditsia (large, flat pods).
Hippophaë rhamnoides (yellow berries).
Liquidambar (corky branches).
Pyrus prunifolia (scarlet or yellow fruit).
Quercus alba, pedunculata and tinctoria (keep their leaves).
Quercus macrocarpa (corky branches).
Rhus typhina (scarlet fruit).
Salix vitellina (yellow branches).
Sorbus americana and S. aucuparia (scarlet fruit).

7. VERY TALL TREES.

Gleditsia triacanthos.
Juglans nigra.
Liriodendron Tulipifera.
Picea excelsa.
Pinus strobus.
Platanus occidentalis.
Populus balsamifera.
Populus deltoides.
Quercus macrocarpa.
Quercus palustris.
Quercus rubra.
Quercus velutina.
Taxodium distichum.
Ulmus americana.

8. COLUMNAR OR NARROW PYRAMIDAL TREES.

Abies (most species).
Acer saccharinum var. pyramidale.
Acer saccharum var. monumentale.
Betula pendula var. fastigiata.
Carpinus betulus var. fastigiata.
Cephalotaxus Harringtonia var. koraiana.
Chamæcyparis Lawsoniana.
Chamæcyparis nutkaensis.
Juniperus communis var. suecica.
Juniperus virginiana (especially var. pyramidalis).
Liriodendron Tulipifera var. pyramidalis.
Picea (most species).
Populus alba var. Bolleana.

COLUMNAR OR NARROW PYRAMIDAL TREES, continued.

Populus nigra var. italica.
Quercus pedunculata var. pyramidalis.
Robinia pseudacacia var. pyramidalis.
Sorbus hybrida.
Taxodium distichum (especially var. imbricarium).
Taxus baccata var. fastigiata.
Thuya.
Ulmus campestris var. monumentalis.
Ulmus scabra var. fastigiata.

9. ROUND-HEADED TREES.

Acer platanoidea var. globosum.
Æsculus Hippocastanum var. umbraculifera.
Catalpa bignonioides var. nana.
Fraxinus excelsior var. globosa.
Morus alba var. nana.
Prunus Mahaleb var. globosa.
Robinia Paeudacacia var. umbraculifera.
Ulmus campestris var. gracilis.
Ulmus campestris var. umbraculifera.

10. WEEPING TREES.

Acer saccharinum var. Wieri.
Betula alba var. pendula.
Cratægua monogyna var. pendula.
Fagus sylvatica var. pendula.
Fraxinus excelsior var. pendula.
Fraxinus parvifolia var. pendula.
Gleditsia triacanthos var. pendula.
Prunus pendula.
Prunus serotina var. pendula.
Quercus pedunculata var. Dauvessei.
Salix babylonica.
Salix blanda.
Salix vitellina var. pendula.
Sophora japonica var. pendula.
Sorbus aucuparia var. pendula.
Tilia petiolaris.
Ulmus scabra var. pendula.

11. CITY TREES. (See also No. 12.)

Ailanthus altissima (pistillate tree).
Carpinus.
Celtis occidentalis.
Cratægus oxyacantha.
Fraxinus americana.
Fraxinus excelsior.
Ginkgo biloba.
Gleditsia triacanthos.
Platanus orientalis.
Populus deltoides. } (often attacked by borers).
Populus nigra var. italica }
Prunus serotina.
Robinia Pseudacacia (often attacked by borers).
Sophora japonica.
Tilia tomentosa.
Tilia ulmifolia.
Ulmus americana.
Ulmus campestris.

12. SHADE AND AVENUE TREES.

Besides the trees enumerated under city trees, No. 11 (which are to be recommended as street trees in the cities), the following trees are good avenue subjects:

Acer platanoides.
Acer rubrum.
Acer saccharinum.
Acer saccharum.
Æsculus carnea.
Æsculus Hippocastanum.
Catalpa speciosa.
Liquidambar styraciflua.
Liriodendron Tulipifera.
Quercus alba.
Quercus coccinea.
Quercus imbricaria.
Quercus palustris.
Quercus phellos.
Quercus rubra.
Tilia americana.
Tilia dasystyla.
Tilia ulmifolia.

13. TREES FOR SEASIDE PLANTING.

Ailanthus altissima.
Cratægus oxyacantha.
Elæagnus angustifolia.
Hippophaë rhamnoides.
Juniperus virginiana.
Picea alba.
Pinus nigra.
Pinus sylveatria.
Populus deltoides var. carolinensis.
Populus tremuloides.
Quercus rubra.
Salix alba.
Salix caprea.
Sassafras.
Tamarix.

14. TREES FOR DRY SITUATIONS AND DRY CLIMATES.

Acer campestre.
Acer ginnala.
Alnus rugosa.
Betula pendula.
Cornus mas.
Elæagnus angustifolia.
Fraxinus pubescens.
Phellodendron amurense.
Pinus divaricata.
Pinus rigida.
Pinus sylvestris.
Quercus coccinea.
Quercus Prinus.
Quercus rubra.
Quercus velutina.
Ulmus effusa.

15. Trees for Wet Soil.

Acer rubrum.
Acer saccharinum.
Alnus glutinosa.
Alnus maritima.
Betula alba.
Betula nigra.
Carya laciniosa.
Chamæcyparis thuyoides.
Nyssa sylvatica.
Picea alba.
Picea mariana.
Pinus rigida.
Populus (most species).
Quercus alba.
Quercus bicolor.
Quercus palustris.
Quercus phellos.
Salix (most species).
Taxodium distichum.

Alfred Rehder.

Choice of street trees for special regions

Trees for the Eastern Part of the Continent.

Street trees for New England and northern New York.

Urban.	Suburban.
Acer platanoides.	Acer rubrum.
Platanus orientalis.	Acer saccharum.
Quercus rubra.	Fraxinus americana.
Tilia americana.	Platanus occidentalis.
Ulmus americana.	Quercus alba.
	Quercus palustris.

From New York City and Pennsylvania southward even to Georgia along the mountains.

Urban.	Suburban.
Acer platanoides.	Acer rubrum.
Ginkgo biloba.	Acer saccharum.
Platanus occidentalis.	Fraxinus americana.
Platanus orientalis.	Liquidambar styraciflua.
Quercus coccinea.	Liriodendron Tulipifera.
Quercus palustris.	Quercus alba.
Quercus rubra.	Quercus bicolor.
Tilia americana.	
Ulmus americana.	

The coast region from Norfolk southward and along the Gulf of Mexico, except southern Florida.

Urban.	Suburban.
Liquidambar styraciflua.	Magnolia acuminata.
Quercus laurifolia.	Magnolia grandiflora.
Quercus nigra.	Magnolia tripetala.
Quercus phellos.	Nyssa sylvatica.
Quercus virginiana.	

North central states.

Urban.	Suburban.
Celtis occidentalis.	Acer rubrum.
Native oaks.	Acer saccharum.
Tilia americana.	Fraxinus americana.
Ulmus americana.	Platanus occidentalis.

Add to the above list for points south of Cleveland, Chicago and Omaha.

Urban.	Suburban.
Acer platanoides.	Liquidambar styraciflua.
Ginkgo biloba.	Liriodendron Tulipifera.
Platanus orientalis.	Platanus occidentalis.
Quercus coccinea.	
Quercus palustris.	
Quercus rubra.	

Most points in northern Alabama, northern Mississippi, southern Arkansas, Oklahoma, and part of Texas back of the coast region are adapted to the trees of both the northern list and the list for the south Atlantic and Gulf coast regions.

F. L. Mulford.

Ornamental trees for the middle and southern states.

Deciduous trees.

Acer saccharinum (*A. dasycarpum*) and *A. Negundo*, the latter extensively used for street planting.—*Broussonetia papyrifera*, formerly planted along streets, but objectionable because of the many suckers which they produce, as is also *B. Kazinoki*.—*Cercis canadensis*. Valuable as an early spring-flowering tree.—*Celtis Bungeana*. One of the most distinct trees; an excellent shade tree.—*Catalpa*. Seldom planted South as an ornamental tree, because of the repeated attacks of caterpillars. The latter are frequently used for fish bait.—*Cladrastis tinctoria*. Very desirable as a flowering lawn tree.—*Cornus florida*. The white-flowering species is among the most attractive of our early spring-blooming trees and is largely used in landscape work. The pink- and red-flowering forms are exceedingly beautiful.—*Cratægus*. Taking into account the various shapes, the foliage and the bright-colored fruit in fall and winter, the best are: *C. Phænopyrum* or Washington thorn, *C. arborescens*, *C. spathulata* and *C. æstivalis* or apple haw.—*Chilopsis saligna*, known as *C. linearis*, is one of the best for dry soils. The typical species produces lilac-colored flowers, but several forms have lately been produced with flowers ranging from light lilac to lilac-purple with yellow stripes inside. A pure white-flowering form is very striking but is of more dwarf habit.—*Diospyros virginiana*. Sometimes planted for shade or for its fruit. Adapts itself to nearly all soils. There are many forms varying both in the foliage and size and shape of fruit.—*Fagus grandifolia* is frequently used for street planting in sandy soils. The red-leaved forms of the European species are of little value South, the purple tint of the foliage fading to a dull green at the approach of warm weather.—*Fraxinus acuminata* and *F. pubescens*. Both thrive best in rich soils and are very desirable for street planting, being seldom attacked by insects.—*Ginkgo* or *Salisburia* is sometimes used for avenues and street planting where a rigid pyramidal tree is required. The foliage is one of its attractions, being shaped like the maidenhair fern.—*Gleditsia triacanthos*. The fertile tree is sometimes planted for its large falcate pods, which are relished by many for the saccharine acidulated pulp. The finely pinnate foliage is very ornamental.—*Halesia tetraptera*. In the middle sections of the South and in rich, dry soils it grows to a small tree, but in the mountain districts in rich soils along the water-courses, trees 40 to 50 feet high are frequently found. Valuable for landscape planting.—*Carya* or Hicoria. The pecan is the best southern nut tree and is very largely planted for its nuts. It is often planted in avenues for its beauty.—*Carya myristicæformis* is scarce, but its foliage is more attractive than that of any other species.—*Hovenia dulcis*. The foliage and the fleshy red peduncles in autumn make it an excellent shade and ornamental tree.—*Idesia polycarpa*. A handsome tree when grown in partial shade; the bark blisters in full sun.—*Juglans*. *J. nigra* is one of the most valuable ornamental and economic trees and is extensively planted for avenues. The Persian or English walnut and its many forms are being more largely planted than of old, but are often injured by late spring frosts following a warm period during February. *J. Sieboldiana* is a very ornamental tree and very productive at an early age. *J. cinerea* is suited only to the mountain regions of the South.—*Kœlreuteria paniculata*. Very desirable for its pinnate foliage and panicles of yellow flowers, which are succeeded by bladder-like fruits.—*Lagerstræmia indica*. The crape myrtle is one of the most characteristic features of southern homes. It has become almost naturalized South. If trained to a single stem, it will form a tree 25 to 30 feet high; otherwise it affects the bush form. It is conspicuous for its shining brown bark and the profusion of its beautifully crimped and fringed flowers, which are produced from April until August. The colors vary from a pale to a dark pink, purplish red, pure white and glowing crimson. No other flowering tree can surpass it in beauty, and by a judicious selection of the various colored flowers a grand effect is produced in landscape work.—*Liriodendron Tulipifera*. One of the most valuable and rapid-growing shade and ornamental trees; thrives best in rich soil. Trees taken from woods transplant badly. They should be grown in nursery and occasionally transplanted until sufficiently large for using in street planting.—*Liquidambar*. A most symmetrical shaped tree; adapts itself to all soil; valuable for street planting. Some trees

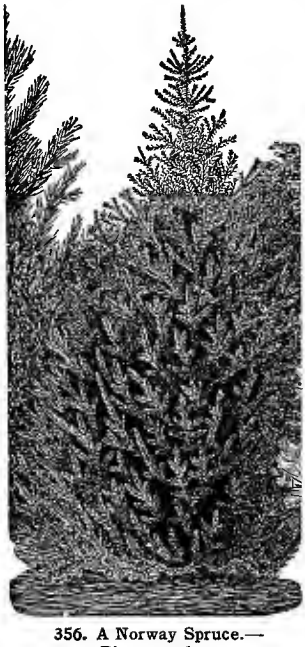
assume a deep purple or crimson tint in the foliage during autumn, others a golden yellow.—*Magnolia.* Of the native deciduous species, *M. acuminata* is the most desirable for street and avenue planting. All the species are voracious feeders and thrive best in rich soils. *M. macrophylla,* or umbrella magnolia, seldom grows beyond 25 feet, but is conspicuous for the length and size of its leaves. This tree is called umbrella tree South, whereas this name applies to *M. tripetala* at the North. *M. Fraseri,* ear-leaved magnolia or wahoo of the western North Carolina mountaineers, is also a very ornamental tree. *M. tripetala* is objectionable in gardens owing to the unpleasant odor of its flowers. Few Chinese species, with the exception of *M. hypoleuca,* attain the size of a tree. *M. denudata* and *M. Soulangeana* can be trained to a single stem and made to attain a height of 25 feet. All the other varieties may be classed as shrubs. The flowers are often injured by late spring frosts.—*Melia Azedarach* (Pride of India, Chinaberry). Almost naturalized South. It is of very rapid growth and begins to flower at an early stage. The flowers are delightfully fragrant, with the perfume of the lilac. Extensively planted for shade trees. The umbrella form, known as Texas umbrella, assumes a dense, spreading head with drooping foliage. It is of unique appearance and can be used with great effect in landscape work.—*Morus. M. rubra* is frequently planted for shade; it is valuable for its wood, which is of great durability for posts. *M. alba* is naturalized in many sections. A form of *M. rubra* discovered in middle Georgia some years ago and called the Stubbs mulberry, from the discoverer, produces enormous crops of large, rich vinous fruit. This and the Hicks and Downing varieties are often planted for feeding poultry and hogs. They should not be planted near dwellings, owing to the dropping of the fruit.—*Nyssa sylvatica.* Only desirable in landscape work for the brilliant red tint of its autumn foliage.—*Oxydendrum arboreum.* Desirable for its flowers and highly colored autumn foliage.—*Parkinsonia aculeata.* Retoma or horse bean of southern Texas. A small tree with green bark, feathery foliage and yellow flowers. Valuable for shrubberies.—*Paulownia tomentosa.* Rapid-growing. Almost naturalized in some sections of the South. The foliage in young trees is very large. Flowers pale violet, very fragrant, in long panicles; they open before the leaves appear.—*Peach.* There are many ornamental varieties which are exceedingly handsome while in bloom, especially the double-flowering crimson, white and pink; others are desirable for their peculiar growth, as Pyramidalis, which is as erect as a Lombardy poplar. Weeping, willow-leaved, and golden-leaved varieties are interesting.—*Prunus.* Hortulana or Chicasaw plums are sometimes planted for ornament, though commonly for fruit. *P. virginiana* is abundant everywhere but not valued owing to being usually infested with tent caterpillars. *Prunus Pissardii* is the best purple-leaved tree for the South, as it retains its color during summer. —*Pinckneya pubens.* This very ornamental small tree is seldom seen under cultivation, as it grows naturally in wet and boggy soils.—*Pyrus coronaria.* The crab-apple, a small tree with very fragrant flowers in spring, is excellent for shrubberies.—*Platanus occidentalis.* One of the most desirable trees for street planting.—*Populus.* The variety used most freely for street planting is *P. deltoides* or *P. monilifera,* commonly known in the South as cottonwood. It is of rapid growth and thrives in nearly all soils that are not too arid. All southern nurserymen catalogue the Carolina poplar, but the stock is not always true to name.—*Pterocarya fraxinifolia,* or Caucasian wing-fruited walnut, is a very rapid-growing tree, with spreading branches and pinnate foliage. Very ornamental when covered with pendulous racemes of small winged nuts, which, however, are of no economic value.—*Quercus.* Nearly all the species of the middle and eastern states are found more or less abundant in the middle South, but the most valuable purely southern species are as follows: *Q. phellos,* or willow oak, with lanceolate leaves; *Q. aquatica,* or water oak, with leaves almost perennial, oblong and obtusely lobed. Both are largely planted for streets and shade, as they grow very rapidly and in almost any soil. *Q. falcata, Q. laurifolia, Q. phellos* and *Q. Muhlenbergii* are desirable. *Q. virginiana,* or live oak, is a very large tree, seldom exceeding 50 feet in height but covering a large circumference. It is native along the seacoast and adapts itself to inland sections, where it does not attain the great size of the coast region. There is no southern tree, except *Magnolia grandiflora,* that is more admired, especially when planted in avenues.—*Sapindus marginatus.* The globose yellow berries are retained during winter. Berries when boiled produce a saponaceous fluid.—*Stillingia sebifera.* Naturalized on the coast of Georgia and South Carolina. The acuminate rhomboidal leaves give the tree a unique appearance. Requires rich soil and is valuable in landscape work.—*Symplocos tinctoria.* Not common. Should be available for shrubberies.—*Tilia pubescens.* A large tree occasionally found in rich soils along the seacoast. Differs little in general from *T. americana,* but seems to be better suited to the middle South. Very desirable for street planting or shade.—*Toxylon,* or *Maclura,* is naturalized in many sections of the middle South. Grows to a height of 30 feet and the fertile trees are very ornamental when laden with their large, globular fruit. The wood is very lasting when used for posts and takes a beautiful polish.—*Ulmus americana* is perhaps more largely planted for streets and avenues than any other deciduous tree.—*Viburnum prunifolium* (black haw or possum haw). In very rich

355. Avenue of live oaks, Audubon Park, New Orleans.

soils sometimes attains a height of 15 to 20 feet. The dark blue berries are retained during winter. Desirable for shrubberies.

Broad-leaved evergreen trees.

Camellia japonica. Although these magnificent plants are usually seen in bush form, they can be trained to single stems and attain a height of 20 or more feet in the coast region, where they have found a congenial soil and climate. The typical single red variety, a tree of which is growing at Charleston, S. C., and planted in 1808, being the first introduced, is now upwards of 20 feet high. The double-flowering sorts, while usually of vigorous growth, do not attain the size of the single red.—*Cinnamomum Camphora.* In southern Louisiana and middle Florida trees grow to a height of 50 feet; in the middle South they affect the bush form or when trained to single stems exceed 15 to 20 feet. For the extreme South it is recommended for street planting.—*Cyrilla racemiflora.* Specimens are occasionally found on shady banks of streams, where the soil is very rich, that will grow 20 feet high, but the tree form must be secured by pruning. The foliage assumes a bright red or bronze tint in winter.—*Eriobotrya japonica.* Flowers produced in January, and if not frost-killed are followed by a golden yellow plum-like fruit of good flavor. Reaches a height of 20 or more feet in the coast belt.—*Gordonia Lasianthus.* A stately tree found only in shallow swamps or turfy soils. The roots spread almost entirely near or upon the surface of the ground, which makes it difficult to transplant trees taken from the woods. Trees grown from seed in pots are best for planting, but a rich moist soil is necessary to their growth.—*Ilex. I. opaca* and *I. Dahoon* are among the most valuable evergreen trees, the former being the best where a large tree is desired. Specimens taken from the woods should not exceed one foot in height, as larger sizes almost always fail in transplanting.—*Ligustrum. L. japonicum* often forms a tree 25 feet high. Berries blue-black, retained during winter.—*Magnolia. M. grandiflora* is justly considered the glory of southern broad-leaved evergreen trees. There are many forms, based on the size and shape of the leaves and the flowers. The superb white flowers, which are seen from May until August and occasionally upon some trees as late as October, vary from 4 to 12 inches in diameter. Thrives as far north as Washington, D. C. *M. glauca* has white flowers 2 to 3 inches in diameter and delightfully fragrant.—*Osmanthus fragrans* var. *ruber* and *O. Aquifolium* var. *ilicifolius*, can be trained to single stem. The flowers of the first are delicately fragrant and produced twice a year.—*Persea carolinensis.* Planted for shade in rich soils in the coast belt.—*Photinia serrulata*, or Chinese evergreen thorn, has white flowers and dark red autumn foliage.—*Prunus carolinensis.* Known south as Carolina Cherry, Carolina laurel, mock orange, etc. One of the most ornamental southern trees.—*Quercus Suber.* Acorns were distributed by the United States Patent Office in 1860, and many large trees are now found in several sections of the South, where they have fruited. Some small plantations are made for the purpose of producing cork. It grows well in comparatively poor and stony soils.—*Sabal Palmetto* is now freely used for street and avenue planting on the coast. It is conspicuous for its tropical appearance. It is not entirely successful further than 40 miles from the seashore.



356. A Norway Spruce.—Picea excelsa.

Conifers or narrow-leaved evergreens.

Abies. Of this section few specimens are found below the Piedmont region. Occasionally the Norway spruce grows to a moderate size.—*Cedrus Deodara.* An admirable tree and of rapid growth, 40 to 50 feet. *C. atlantica.* 25 to 30 feet.—*Cunninghamia lanceolata.* Foliage resembles an araucaria.—*Cupressus. C. sempervirens* has many forms, from the compact, spiral or shaft-like shape to more spreading habit. *C. lusitanica* or cypress of Goa, has numerous forms with foliage of an ashy green and pendulous branches, to others of a more dark tint and rigid form. Of *Chamæcyparis Lawsoniana* there are endless forms, from a compact, erect habit and vivid green foliage to those of open or pendulous shape and with glaucous or golden foliage. *Cupressus funebris* has varied less in its seedlings.—*Juniperus.* The Irish juniper is of fine pyramidal form, and reaches a height of 15 feet. *J. excelsa, J. chinensis* and *J. thurifera* differ in the tint of their foliage and are all of tall growth.—*Libocedrus decurrens.* The California arborvitæ, with its graceful feathery foliage and conical shape, is one of the most ornamental of conifers.—*Pinus.* Few of the exotic species are suitable to the South. *Pinus excelsa*, or Bhotan pine, is undoubtedly the best adapted to the middle South of all kinds.—*Retinispora* is a valuable group of Japanese cypress, but with the exception of *R. obtusa, R. Fullerii, R. plumosa* and *R. squarrosa Veitchii*, all are of dwarf habit.—*Thuya.* The Asiatic section is better adapted to the middle South than the American species. Of the former the best forms are known to nurseries as *Biota pyramidalis* and var. *aurea*, reaching a height of 15 to 18 feet. *B. japonica* var. *filiformis* (*Thuya orientalis*) is a remarkable variety, with thread-like foliage and compact habit to 10 to 12 feet.

In the foregoing list of Coniferæ no mention is made of species or varieties of low or shrub-like growth, such as Podocarpus, Cephalotaxus, Thuyopsis, and Sciadopitys, of which there are many good specimens in various parts of the south. Araucarias are also omitted, owing to their liability of failure from extreme heat or other unfavorable climatic conditions. This applies also to Sequoia, and Frenelas (properly Callitris); these frequently make an extraordinarily rapid growth until late in autumn, and are often injured by a cold wave early in winter. P. J. Berckmans.

Trees on the Great Plains.

The Plains, lying mostly west of the Missouri River, are not absolutely treeless, as strangers often suppose, but the whole vast area is dotted here and there with small groves, or narrow belts that fringe the borders of the streams. The number of native species, however, is much smaller than in the rich tree flora of the north-eastern United States and Canada. The number of species cultivated for shade and ornament, for a long time, at least, must be relatively small, owing to climatic and other causes. In general, the people of the Plains are necessarily more interested at present in planting trees for profit than for pleasure, but in the older parts are already to be found many fine public parks and private grounds. To a large extent, however, their point of view is that of forestry rather than horticulture.

In studying the forest trees of the Great Plains of central North America, it is found that most of the species have migrated out upon the Plains from the great forest body of the Mississippi Valley. These trees found their way upon the Plains by way of the forests that border the Missouri River and its tributaries. As we pass down the river, along the eastern edge of the Plains, the forest belt becomes larger and larger, until it eventually merges into the great body of forest trees lying on the easterly side of the Mississippi Valley. The principal trees that have come upon the Plains by this route are the common red cedar, papaw, half a dozen willows, one cottonwood, basswood, two or three elms, hackberry, mulberry, three ashes, wild apple, four or more species of hawthorns, juneberry, wild cherry, choke cherry, wild plum, coffee bean, honey locust, redbud, sycamore, two species of buckthorns, buckeye, one maple, box elder, sumach, two species of walnuts, five or six hickories, nine or ten oaks, ironwood, blue beech, and one birch. But ten species of trees have come from the Rocky Mountain forests, and these have made much less impression upon the forests of the Plains than those that came from the eastern forests. In this list are the bull-pine, the western red cedar, four species of cottonwoods, the buffalo berry, a maple, and two birches.

Although the present forest area of the Plains is not relatively great, it is large enough to be seriously considered in regard to its preservation. There is danger that with the habit acquired by our people in the thickly wooded parts of the United States of cutting down forest trees wherever found, much of this small forest area will be destroyed. It is much easier to preserve an area of forest growth than to create it anew. First, all forest fires must be kept down. When a mass of woodland adjoins the open prairie, fire-guards should be made so that the fires will not sweep into the forest growth. The greatest destroyer of the forests of the Plains in the past has been fire, as it swept over the prairies into woodland. Second, it is absolutely necessary to keep out certain kinds of stock. Swine, if herded in large numbers, will inevitably destroy the trees. They prevent the growth of small trees, and eventually destroy those of larger growth. Cattle, in large numbers, are equally destructive. In fact, when the attempt is made to preserve uninjured the trees in a forest, it is necessary to keep out stock of all kinds, excepting possibly during limited portions of the year. Third, it is necessary to cut out the trees for use with very great care. A forest should be a permanent crop, and the cuttings should be so made that the forest as a whole is not injured. Trees should be cut here and there in such a way that the young trees which are left have an opportunity for growing into usable timber.

Care should be taken to encourage the tendency to spreading which is so strong in nearly all parts of the Plains. With a little care every present living forest area may be made to extend itself spontaneously, or nearly so. The forest should be effectually inclosed by a fence, placed at some distance from its outer border, leaving a belt of unoccupied land between the trees and the fence. This will grow up with weeds, and mingled with these will be the seedling trees springing from the seeds blown or carried from the forest area. In this way the border of the forest will be gradually extended. This can be helped by plowing up these inclosed belts of land, giving better opportunity for the starting of seedling trees. With the weeds and little trees will spring up low shrubs of various kinds. These need give no trouble, for this is merely Nature's way of taking possession of the soil. Little, if any, cultivation need be given to such a nursery belt, as the weeds which spring up, while unsightly, will serve the useful purpose of sheltering the little trees, and eventually the trees will rise above, and choke them out. Grass, however, forming a tough sod, is harmful to the little trees, far more so than the ordinary weeds.

There are many places in which actual planting must be resorted to. In looking about for a site for the new forest plantation, it must be remembered that the best conditions for tree growth are usually to be found near the natural forests. Where there are natural forests, the planting should be around their borders, so as to extend them in much the same way as indicated in the preceding paragraph in regard to natural spreading. Where there are no natural forests at all, it is necessary to select the more favorable places for planting. Since the natural forests on the Plains occupy the depressions rather than the hilltops or the slopes, this should give

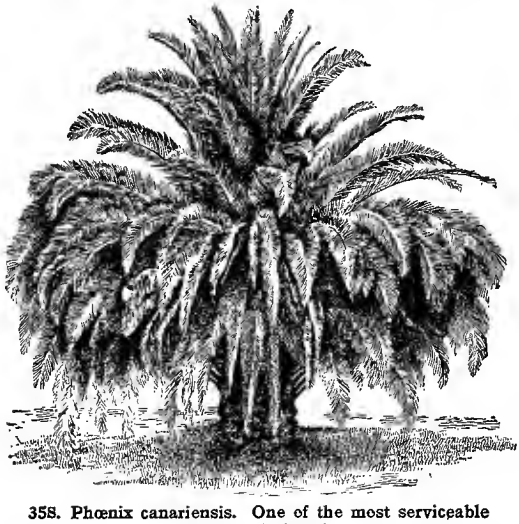
357. A good field elm.

one a hint as to what must be done. Wherever the land slopes into a depression, one may find favorable conditions for growing trees. These depressions, generally called "draws," may be filled with trees, and when once a growth of a few acres is secured it will not be difficult to extend the forest far up the hillside slopes. On the western parts of the Plains similar positions should be taken under the irrigation ditches. In the selection of trees for the formation of forest areas, one should also take a hint from nature. The rule, which is a very excellent one for the plainsman to follow, is to plant on his farm the kinds that he finds in the nearest forest, and to give his planted trees as nearly as possible the same conditions as those under which they grew in the native forest. On the eastern third of the Plains, the walnut, white oak, shellbark hickory, white elm, red elm, hackberry, white ash, wild cherry, catalpa and honey locust are recommended for planting. On the extreme eastern parts bordering the Missouri River, many more kinds can be planted, but as one passes westward toward the borders of the Sand Hill region the list grows smaller. On the central Plains the list is reduced, and also somewhat changed in species. The two elms may be planted, as also the hackberry, the green ash in place of the white ash, wild cherry, honey locust, and in many places the bull-pine. On the western Plains, especially that portion lying west of the main body of the Sand Hills, and having an elevation above the sea of from 3,000 to 4,000 feet, the list is still smaller. The white elm is still included, also the hackberry, the bull-pine, and in many places the red cedar.

The trees mentioned are of the more durable and profitable kinds. But on all parts of the Plains persons must often have quick-growing trees, which soon produce fuel, but which have little, if any, value for other purposes. In the eastern part of the Plains, the black willow, almond willow, common cottonwood, silver maple, and box elder are useful trees for this purpose. One should not condemn the use of these easily grown, soft-wooded trees. A forest is a crop, and there is no reason why a farmer may not plant a more quickly growing crop if he wishes, but he should at the same time plant the more enduring kinds given in the preced-

ing lists. On the central Plains the quickly grown trees may include the same willows and cottonwood and also the box elder. The silver maple will not do well in the greater part of this central region. On the western Plains the list is essentially the same as for the central portion: namely, the willows, cottonwood, and the box elder, to which may be added, here and there, one or more of the western species of cottonwood.

The horticultural point of view is to be considered. About country homes the first trees are usually cottonwood, silver maple and box elder, followed later by green ash and white elm. Very commonly the red cedar is planted with the first-mentioned species, and often Scotch and Austrian pines are added. It must be remembered that the settler's house on the Plains stands in the open instead of being hemmed in by forest trees, as in the eastern parts of the American continent. The settler's problem is to surround his house with trees, not to clear the trees away. In towns and cities the cottonwood, silver maple and box elder are generally the pioneer trees, since they produce a shade sooner than any others, and later these are gradually replaced by



358. Phœnix canariensis. One of the most serviceable palms in California.

green ash and white elm. Hackberry, black walnut and buttonwood are occasionally planted with good success. The species which are most largely used for windbreaks for orchards and other plantations are common cottonwood, willow (a variety of *Salix alba*), silver maple and box elder. The first mentioned, because of its easy propagation, rapid growth and extreme hardiness, is the favorite tree for this purpose. When landscape gardening is attempted, the Scotch and Austrian pines, Norway spruce and red cedar are generally used, and to these are often added one or more species of the Rocky Mountain spruces. The most generally used deciduous tree for this purpose is the white elm (which here attains to a singular beauty of form and foliage), to which are occasionally added bur oak, black walnut and Russian olive (Elæagnus), and in proper situations, the white willow. The coniferous trees of greatest value for ornamental purposes on the Plains are the Austrian pine, Scotch pine and red cedar. With proper care these may be grown on all parts of the Plains where water enough to maintain life may be obtained. On the extreme eastern border, the Norway spruce and even the balsam fir have proved valuable. Among deciduous trees the white elm holds first place, followed by the hackberry (which is not so much planted as it deserves) and the green ash.

CHARLES E. BESSEY.

TREES FOR PLANTING ON THE GREAT PLAINS. The asterisks (*) indicate those trees that are not native to the regions.

1. *For the eastern plains.*

Abies balsamea.*	Picea excelsa* (Fig. 356).
Abies concolor.*	Picea pungens.*
Acer platanoides.*	Pinus austriaca.*
Ailanthus altissima.*	Pinus sylvestris.*
Carya ovata.	Prunus serotina.
Catalpa speciosa.*	Quercus alba.
Celtis occidentalis.	Robinia Pseudacacia.*
Fraxinus americana.	Salix vitellina.*
Gleditsia triacanthos.	Ulmus americana (Fig. 357).
Juglans nigra.	Ulmus fulva.
Picea alba.*	

and the following quick-growing but temporary trees:

Acer Negundo.	Salix amygdaloides.
Acer saccharinum.	Salix nigra.
Populus Sargentii.	

2. *For the central plains.*

Catalpa speciosa.*	Pinus scopulorum.
Celtis occidentalis.	Prunus serotina.
Fraxinus lanceolata.	Robinia Pseudacacia.*
Gleditsia triacanthos.	Ulmus americana.
Picea canadensis.*	Ulmus fulva.
Pinus divaricata.*	

and the following quick-growing but temporary trees:

Acer Negundo.	Salix amygdaloides.
Populus Sargentii.	Salix nigra.

and in the southern parts:

Elæagnus angustifolia.*	Pinus austriaca.*
Maclura aurantiaca, Nutt.	Pinus sylvestris.*

also black walnut and bur oak if seed is planted where tree is to stand permanently.

3. *For the high western plains.*

Celtis occidentalis.	Pinus scopulorum.
Juniperus scopulorum.	Robinia Pseudacacia.*
Pinus divaricata.*	Ulmus americana.

and the following quick-growing but temporary trees:

Acer Negundo.	Salix amygdaloides.
Populus acuminata.	Salix nigra.
Populus Sargentii.	

and nearer the mountains:

Acer Negundo.	Gleditsia triacanthos.*
Acer platanoides.*	Juglans nigra.*
Elæagnus angustifolia.*	Populus Sargentii.
Fraxinus lanceolata.	Tilia americana.*

Seeds or seedlings grown in the region in which they are to be planted are the most reliable. Young trees or seedlings succeed better than older and larger ones. Varieties native in moist climates or in foreign countries should be avoided unless their adaptability has been proved. Young plants, like young animals, are easily killed and must have extra care.

C. L. WATROUS.
C. E. BESSEY.

Trees grown for shade and ornament in California.

The mild and equable climate of California allows a wide range of available species from which to select trees for shade, ornament and shelter. There is, nevertheless, some considerable variation in the species, which are characteristic of the plantings in different parts of the state, that has arisen from variations in soil and climatic conditions.

On account of the long rainy season, the low humidity of the atmosphere and the relatively high mean, and freedom from low winter minima in temperatures, the trees that thrive best in middle California are those indigenous to the arid and semi-arid warm temperate regions of the globe, e. g., southern Australia, the Mediterranean region, south Africa, northern Mexico and Chile, together with those native species which deserve a place. As one goes into the southern part of the state, some of these species drop out and others markedly

characteristic of arid regions take their place. The reverse of this is true, as one goes north, where many trees of the temperate humid regions also thrive in this state, particularly in the relatively humid climate of the coast, and are offered by our nurserymen.

I. The Species Heretofore Most Extensively Planted in California.

The following trees are perhaps the commonest species found in the plantings:

1. Eucalyptus globulus.
2. Cupressus macrocarpa.
3. Pinus radiata.
4. Robinia Pseudacacia.
5. Acacia melanoxylon.
6. Schinus Molle.
7. Acacia decurrens var. dealbata.
8. Acacia decurrens var. mollis.
9. Melia Azedarach var. umbraculiformis.
10. Phœnix canariensis (Fig. 358).
11. Magnolia grandiflora.
12. Ulmus racemosa and species.
13. Cordyline australis (Fig. 359) and species.
14. Acer Negundo, and var. californica.
15. Araucaria Bidwillii.
16. Araucaria excelsa.
17. Populus deltoides var. carolinensis.
18. Juglans californica and species.
19. Salix babylonica.
20. Acer saccharinum.
21. Eucalyptus robusta.
22. Eucalyptus viminalis.
23. Eucalyptus rostrata (Fig. 360).
24. Acer macrophyllum.
25. Pittosporum species.
26. Cedrus Deodara and species.
27. Betula alba.
28. Grevillea robusta.
29. Washingtonia filifera.
30. Cinnamomum Camphora

II. Trees Being Most Extensively Planted in California at the Present Time.

The following list, arranged in sequence according to the actual number of sales made during the season of 1911–12, is compiled from data furnished by W. B. Clarke, of the California Nursery Company, at Niles. The percentages refer only to the twelve species here enumerated, and not to the total number of trees sold by the nursery, which has a large and varied assortment of species, many of which are more suitable and more effective than those for which there is, at present, the greatest demand.

	Per cent.
Eucalyptus globulus	40.8
Cupressus macrocarpa	12.0
Platanus orientalis	11.4
Eucalyptus rostrata	10.2
Populus nigra italica	6.2
Pinus radiata	5.0
Acacia decurrena dealbata	3.5
Acacia melanoxylon	3.0
Populus deltoides var. carolinensis	2.2
Robinia Pseudacacia var. Decaisneana	2.0
Acer saccharinum	2.0
Schinus Molle	1.7

III. Selections for Special Purposes.

The following lists are from species now offered in the California trade and are intended to be suggestive only, and not by any means complete. New species and varieties are constantly being added to the nursery stocks, some of which will be found particularly well adapted to certain conditions of climate and soil, and will doubtless replace others now in use.

1. *For subtropical effect.*

That there is in California strong appreciation of subtropical effects in gardening is shown by the great demand for dracenas and such large-leaved plants as palms, magnolias, bananas and rubber trees. That the effect produced by the planting of such trees so often fails to be satisfatory is largely due to one or both of two causes,—either unsuitable location of the specimens, or choice and association of unsuitable species. To prevent a repetition of the first-named error, the prospective tree planter is recommended to consult the article on Landscape Gardening; and to avoid the second, a selection from the following list is suggested, with the addition of such large-leaved herbaceous plants as cannas, colocasia, cynaras, funkias, *Gunnera scabra*, pampas grass, veratrums, agaves, yuccas, aloes, *Woodwardia radicans* and *Rodgersia podophylla*, together with such shrubby plants as bamboos, giant reed, the choicer varieties of castor-bean, *Senecio grandifolius*, *Polygonum sachalinense* and *P. Sieboldii*.

A. *Small trees or tall shrubs.*

Acanthopanax ricinifolium.
Aralia chinensis.
Aralia chinensis var. mandschurica.
Aralia spinosa.
Arundinaria falcata.
Chamærops humilis.
Dicksonia antarctica.
Eriobotrya japonica.
Erythea armata.
Musa Ensete.
Prunus Laurocerasus.
Ricinus cambodgensis.
Ricinus macrophyllus.
Ricinus sanguineus.
Ricinus zanzibarensis.
Tatrapanax papyrifera.

AA. *Larger trees.*

Catalpa bignonioides.
Catalpa ovata.
Catalpa speciosa.
Cordyline australis.
Cordyline Banksii.
Cordyline indivisa.
Cordyline stricta.
Corynocarpus.
Erythea edulis.
Eucalyptus calophylla.
Eucalyptus ficifolia.
Ficus Carica.
Ficus macrophylla.
Gymnocladus canadensis.
Jubæa spectabilis.
Livistonia australia.
Magnolia grandiflora.
Paulownia tomentosa.
Phœnix canariensis.
Phœnix dactylifera.
Phœnix reclinata.
Phœnix Rœbelenii (P. humilis var.)
Phœnix sylvestris.
Phytolacca dioica.
Trachycarpus excelsus.
Tristania conferta.
Washingtonia filifera.
Washingtonia robusta.

Eucalyptus globulus can also be used effectively if cut down periodically when the falcate leaves begin to appear; it will continue to shoot up vigorously from the same root for several years. *E. robusta* is useful for screen purposes if cut down before it becomes straggling. This can also be said for *E. polyanthemos*, *E. rudis*, *E. Risdonii*, and many others. *E. polyanthemos* is certainly more beautiful than *E. globulus* and would not need to be cut down so frequently.

2. *Trees with ornamental flowers (for California)*

In making the following grouping, arranged according to relative hardiness, it has been impossible to give precise information as to the exact degree of frost-tolerance of the several species, as only meager published data on the subject are to be found.

A. *Susceptible to light frost.*

The following would probably succumb to a temperature of 28° F.:

Eucalyptus calophylla.
Eucalyptus ficifolia.
Jacaranda ovalifolia.

AA. *Susceptible to heavy frost.*

The following are not likely to stand a temperature of 20° F. Some of them may succumb at 25° F., particularly when young.

Acacia Baileyana.
Acacia cyanophylla.
Acacia decurrens var. dealbata.
Acacia elata.
Acacia falcata.
Acacia longifolia.
Acacia neriifolia.
Acacia pendula.
Acacia salicina, etc.
Bursaria spinosa.
Eucalyptus cornuta.
Eucalyptus corymboaa.
Eucalyptus polyanthemos.
Eucalyptus sideroxylon var. pallens.
Hymenosporum flavum.

AAA. *Hardy.*

Acacia pycnantha.
Æsculus carnea.
Æsculus Hippocastanum.
Albizzia Julibrissin.
Catalpa bignonioides.
Catalpa ovata.
Catalpa speciosa.
Cercis canadensis.
Cercis Siliquastrum.
Cratægus mollis.
Cratægus monogyna (vars. Paulii, punicea, alba plena, etc.)
Kœlreuteria paniculata.
Laburnum vulgare.
Lagunaria Patersonii.
Magnolia acuminata.
Magnolia grandiflora.
Magnolia Kobus.
Magnolia Soulangeana.
Magnolia stellata.
Paulownia tomentosa.
Prunus Armeniaca (double.-fld.)
Prunus cerasifera var. atropurpurea.
Prunus japonica.
Prunus Persica (white-fld., double red-fld., dark-fld., etc.).
Prunus spinosa (double-fld.).
Pyrus Halliana.
Pyrus ioensis (Bechtel's double crab).
Robinia hispida.
Robinia Pseudacacia and var. rosea.
Sorbus Aucuparia.

3. *Trees with colored foliage.*

A. *Glaucous.*

B. *Susceptible to frost (20° F. and perhaps less).*

Acacia Baileyana.
Acacia dealbata.
Acacia glaucescens.
Acacia salicina.
Cocos australis.
Erythea armata.
Eucalyptus globulus (pollarded to produce suckers).
Eucalpytus polyanthemos.
Eucalyptus Risdonii.
Eucalyptus sideroxylon var pallens.
Leucadendron argenteum.
Phœnix dactylifera.
Washingtonia Sonoræ.

BB. *Hardy.*

Cedrus atlantica var. glauca.
Cedrus Deodara var. glauca.
Picea pungens var. cærulea.
Picea pungens var. glauca.
Sequoia sempervirens var. glauca.

AA. *Purple or bronze.*

B. *Susceptible to 25° F.*

Ricinus cambodgensis.
Ricinus communis var. Gibsonii

BB. *Hardy.*

Acer platanoides var. Reitenbachii.
Acer platanoides var. Schwedleri.
Betula alba var. atropurpurea.
Cryptomeria japonica var. elegans.
Fagus sylvatica var. purpurea.
Fagus sylvatica var. purpurea Riverii.
Prunus cerasifera var. atropurpurea.
Prunus Persica, var.

4. *Wide-spreading trees for shade, mostly with rounded outline.*

It frequently happens that the owner of a California garden desires a wide-spreading tree in the back or one corner of his domain, under which to swing a hammock on a hot day; such trees are also useful in the school-yard, affording welcome shade in which the children can eat their lunch.

A. *Deciduous, all hardy.*

B. *Growth rapid or medium.*

C. *Suckers likely to be troublesome.*

Populus alba.
Robinia Pseudacacia.
Ulmus americana.
Ulmus racemosa.

CC. *Suckers not troublesome.*

D. *Requiring a great deal of water.*

Salix babylonica.

DD. *Requiring not much water.*

Acer macrophyllum.
Acer Negundo.
Acer Negundo var. californicum.
Acer platanoides.
Acer platanoides var. Reitenbachi.
Acer platanoides var. Schwedleri.
Acer pseudoplatanus.
Acer saccharinum.
Acer saccharinum var. Wieri.
Carya illinoensis (Pecan).
Fraxinus americana.
Fraxinus velutina.
Quercus lobata.
Quercus pedunculata.
Ulmus campestris.

BB. *Growth somewhat slow.*

Acer campestre.
Æsculus carnea.
Æsculus Hippocastanum.
Castanea sativa.
Fagus sylvatica var. purpurea.
Juglans Sieboldiana.
Liriodendron Tulipifera.
Melia Azedarach var. umbraculiformis.
Platanus orientalis.
Quercus coccinea.
Quercus Kelloggii.
Quercus lobata.
Quercus macrocarpa.
Quercus rubra.
Sophora japonica.
Tilia americana.
Tilia europæa.
Ulmus campestris.

AA. *Evergreen.*

B. *Growth rapid: trees susceptible to 25° F.*

Acacia decurrens dealbata.
Acacia decurrens mollis.

BB. *Growth somewhat slow: trees hardy.*

Arbutus Menziesii.
Ficus Carica.
Olea europæa.
Pinus Pinea.
Quercus agrifolia.
Quercus Suber.
Schinus Molle.

5. *Ornamental trees affording but little shade.*

A. *Outline long or nearly columnar.*

B. *Deciduous.*

Populus nigra var. italica.
Betula alba.

BB. *Evergreen.*

Cupressus sempervirena.
Cupressus sempervirens var. fastigiata.
Juniperus communis var. hibernica.
Taxus baccata var. fastigiata.

AA. *Outline conical or spiral, usually pointed.*

B. *Coniferæ, with mostly narrow leaves.*

C. *Deciduous: hardy.*

Larix decidua.
Larix leptolepis.
Taxodium diatichum.
Taxodium mucronatum.

CC. *Evergreen.*

D. *Susceptible to severe frost (about 20° F.).*

Agathis robusta.
Araucaria Bidwillii.
Araucaria braziliana.
Araucaria Cookii.
Araucaria Cunninghamii.
Araucaria excelsa.
Araucaria imbricata.
Pinus canariensis.

DD. *Hardy.*

Abiea balsamea.
Abies cephalonica.
Abiea concolor.
Abies nobilis.
Abies Nordmanniana.
Abiea Pinsapo.
Cedrus atlantica.
Cedrus Deodara.
Cedrus Libani.
Cephalotaxus drupacea.
Cephalotaxus Fortunei.
Chamæcyparis Lawsoniana.
Cryptomeria japonica.
Cryptomeria japonica var. elegana.
Cunninghamia sinensis.
Cupressus Goveniana.
Cupressus macrocarpa.
Cupressus guadalupensis.
Libocedrus chilensis.
Libocedrus decurrens.
Picea ajanensis.
Picea canadensis.
Picea Engelmannii.
Picea excelsa.
Picea mariana var. Doumetti.
Picea torano.
Picea pungena.
Pinus contorta.
Pinus Coulteri.
Pinus densiflora.
Pinus Laricio var. austriaca.
Pinus monophylla.
Pinus Pinaster.
Pinus radiata.
Pinus Sabiniana.
Pinus sylvestris.
Podocarpus Totara.
Pseudotsuga Douglasii.
Sciadopitya verticillata.
Sequoia gigantea.
Sequoia sempervirens.
Taxus baccata.
Thuja gigantea.
Thuja orientalis.
Thujopsis dolabrata.
Torreya californica.
Torreya nucifera.

BB. *Foliage broad.*

C. *Deciduous: hardy.*

Betula alba.
Betula lenta.
Betula lutea.
Betula papyracea.
Betula populifolia.
Ginkgo biloba.
Quercus Cerria.
Quercus nigra.
Sorbus Aucuparia.

CC. *Evergreen.*

D. *Susceptible to severe frost (probably 20° F. and even less).*

Cinnamomum Camphora.
Corynocarpus lævigatus.
Cryptocarya Mierii.
Grevillea robusta.
Sterculia diversifolia.
Trietania conferta.

DD. *Hardy.*

Acacia melanoxylon.
Cerasus lusitanica.
Ilex Aquifolium.
Lagunaria Pateraonii.
Laurus nobilis.
Pittosporum crassifolium.
Quercus Suber.
Umbellularia californica.

AAA. *Outline more or less rounded, but trees not as wide-spreading nor as shade-giving as in Class 4.*

B. *Deciduous.*

C. *Susceptible to frost (25° F.).*

Phytolacca dioica.

CC. *Hardy.*

Æsculus glabra.
Fraxinus americana.
Fraxinus excelsior.
Fraxinus Ornus.
Gymnocladus canadensis.
Juglans californica.
Juglans nigra.
Kœlreuteria paniculata.
Paulownia tomentosa.
Robinia Pseudacacia.

BB. *Evergreen.*

C. *Probably susceptible to severe frost (20° F., or less).*

Acacia cyanophylla.
Alectryon excelsum.
Burasaria spinosa.
Eucalyptus calophylla.
Eucalyptus cornuta.
Eucalyptus corymbosa.
Eucalyptus corynocalyx.
Eucalyptus ficifolia.
Eucalyptus globulus.
Eucalyptus maculata var. citriodora.
Eucalyptus robusta.
Hymenosporum flavum.
Maytenus Boaria.

CC. *Hardy.*

Acacia pycnantha.
Eucalyptus amygdalina.
Eucalyptus Gunnii.
Eucalyptus leucoxlyon.
Eucalyptus obliqua.
Eucalyptus rostrata.
Eucalyptus rudia.
Eucalyptus viminalis.
Jubæa spectabilis.
Phœnix canariensis.
Phœnix reclinata.
Phœnix sylvestris.
Pittosporum eugenioides.
Pittosporum tenuifolium.
Pittosporum undulatum.

AAAA. *Drooping trees.*

B. *Deciduous.*

Acer saccharinum var. Wieri laciniatum.
Betula pendula elegans.
Betula pendula laciniata.
Betula pendula Youngii.
Cratægus monogyna var. pendula.
Fagus sylvatica var. pendula.
Fraxinus excelsior var. aurea pendula.
Fraxinus excelsior var. pendula.
Morus alba (Teas' weeping).
Populus grandidentata var. pendula.
Prunus fructicosa var. pendula.
Quercus lohata.
Salix babylonica.
Salix babylonica var. Lickii.
Sophora japonica var. pendula.
Sorbus Aucuparia var. pendula.
Tilia americana var. pendula.
Tilia europæa var. pendula.
Ulmus americana var. pendula.
Ulmus campestris var. pendula.
Ulmus scabra var. pendula.

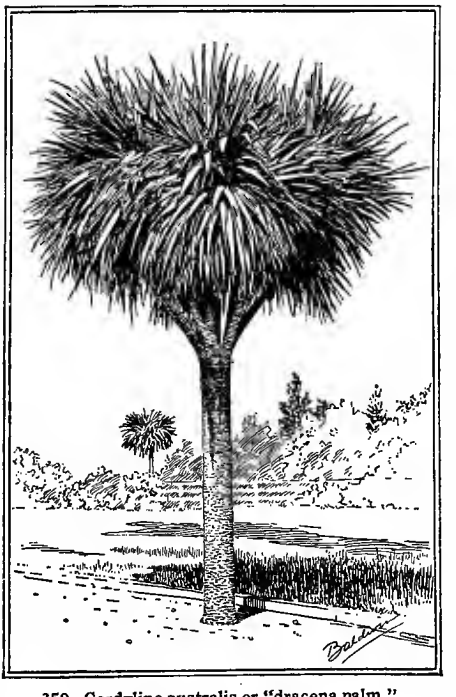
BB. *Evergreen.*

Cupressus funebris.
Cupressus lusitanica.
Schinus Molle.

6. *Trees for streets, avenues and roadsides in California.*

The number of tree species suitable for street planting is limited by the necessarily heavy restrictions, as to height, spread, sewer-penetration and sidewalk-raising, imposed by municipal street departments. In European cities the first-named objections are overcome by means of frequent and systematic pruning to a uniform standard; when this necessity can be obviated by the selection of trees which naturally keep within the desired bounds, the labor of maintaining them in a sightly condition is minimized and the result much more pleasing.

For town streets not more than 60 feet in width, it is important to have trees that will not give too much shade and prevent the rapid drying of the roadway after showers, nor be so tall nor wide-spreading as to obstruct the view and shut out sunshine, rendering the adjacent houses dark, cold and damp. On this account, trees with narrow or pyramidal outline are in many cases preferable to those with wide-spreading habit, and, generally speaking, deciduous trees are more suitable than evergreen, although at the time of losing their leaves they make more litter. Exception may be made in favor of such evergreen species as certain palms and cordylines, some acacias and a few other species mentioned below.



359. Cordyline australis or "dracena palm." Common in California.

It is not wise to use trees of very rapid growth on town streets; they soon become too large and require frequent trimming, which is usually equivalent to mutilation, and are likely to interfere with sewers.

It cannot be said that street planting in California towns has, in most cases, been satisfactory. In spite of the much larger variety of suitable material than is available in most of the states, there are few examples of good street planting to be met with. In most of the towns the eye is greeted with a few straggling trees, of which perhaps not more than two are of one kind, recalling F. A. Waugh's apt simile of "nine monstrously different buttons in a row down the front of a Prince Albert coat." There are many pleasing exceptions, however, although few are entirely satisfactory. The repeated attempts to improve the appearance of a town by planting trees along the streets should be encouraged on every occasion, and the object of this discussion is to render assistance by pointing out how some of the mistakes may be avoided. The unsatisfactory results of street planting, so often met with, can generally be traced to one or all of three causes:

(1) Choice of unsuitable species.

(2) The mixing of several species on the same block and even in front of the same lot.

(3) Crowding of trees.

This last-mentioned source of trouble is perhaps the cause of more failures than the first. When trees are once growing, few persons have the heart to thin out the species for the proper distance apart; finally, a newcomer, without personal feeling in the matter and noting only that there is too much shade and too little light, cuts down the whole row and a gap is left in what may have been a fairly uniform block. Spreading avenue trees of large size should not stand closer than 50 feet apart; smaller trees, on narrower streets, should have 40 feet, unless they are slender species such as cordyline or washingtonias, when 20 feet may be sufficient. As a rule, one small tree to a 50-foot lot will be found ample; if the whole street is planted uniformly with the same species, and at this same distance, the result will be much more pleasing than if four or five trees are planted in front of every house.

This question of spacing can be determined only by the species in use. If 20 feet is added to the diameter of the spread of the crown, an approximate spacing can be secured. For example, cork elms often attain a 60- or 75-foot spread and should be spaced, accordingly, 80 to 100 feet apart. This advice is given from data gathered in various towns where closer plantings were in order, and have already demonstrated how the air, light and heat are shut off by too crowded plantings.

In towns where the climate is very mild, with few extremes, trees are planted only for decorative effect and not for shade,—hence these extreme distances may be used even for species which do not attain great size.

On the other extreme in the interior California valleys, the distances may have to be shortened to allow for the extreme heat, but trees should never be set so closely that the circulation of air is hindered, except of course for windbreak plantings, which are not found on streets as a rule.

A. *For city and town streets.*

B. *Small trees suitable for streets 60 feet wide or less.*

C. *Deciduous.*

D. *Growth rapid or moderate.*

Æsculus carnea.
Betula alba.
Betula lutea.
Betula populifolia.
Catalpa bignonioides.
Catalpa ovata.
Catalpa speciosa.
Kœlreuteria paniculata.
Paulownia tomentosa.

DD. *Growth slow.*

Cratægus mollis.
Cratægus monogyna.
Ginkgo biloba.

CC. *Evergreen.*

D. *Growth rapid or moderate.*

E. *Palms and arborescent Liliaceæ.*

Cordyline australis.
Cordyline Banksii.
Cordyline indivisa.
Cordyline stricta.
Erythea edulis.
Livistona australis.
Trachycarpus excelsus.
Washingtonia filifera.
Washingtonia robusta.

EE. *Evergreen trees other than palms and arborescent Liliaceæ.*

Acacia falcata.
Acacia lineata.
Acacia neriifolia.
Myoporum lætum.
Pittosporum eugenioides.
Pittosporum tenuifolium.

DD. *Growth slow.*

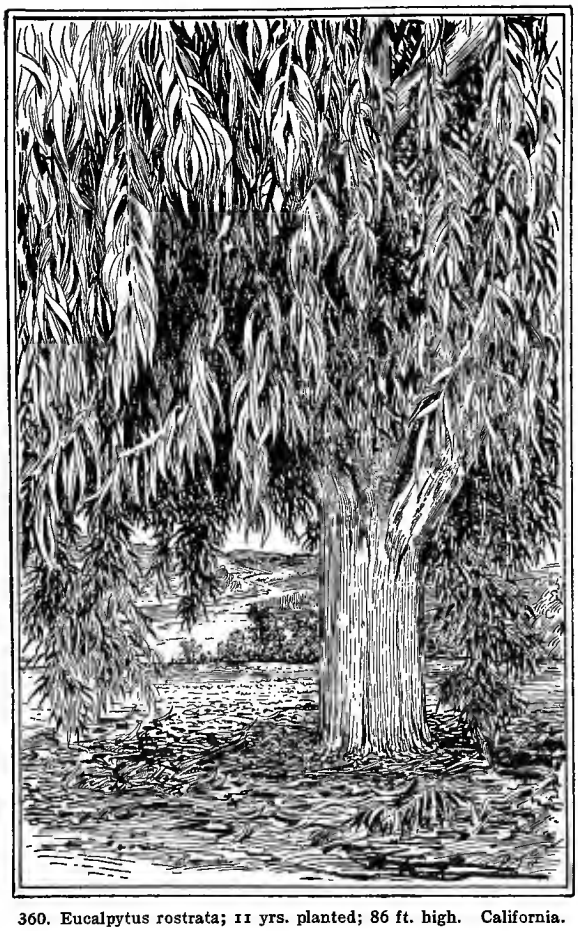
Alectryon excelsum.
Bursaria spinosa.
Cinnamomum Camphora.
Eucalyptus ficifolia.
Ilex Aquifolium.
Jacaranda ovalifolia.
Ligustrum lucidum.
Magnolia grandiflora.
Maytenus Boaria.
Olea europæa.
Pittosporum crassifolium.
Tristania conferta.

BB. *Larger trees for streets, avenues and boulevards 80 to 100 feet wide.*

C *Deciduous.*

D. *Growth rapid or moderate.*

Acer macrophyllum.
Acer saccharinum.
Carya (Pecan).
Fraxinus americana.
Fraxinus velutina.
Gymnocladus canadensis.
Platanus orientalis.
Quercus pedunculata.
Robinia Pseudacacia.
Ulmus campestris.



360. Eucalpytus rostrata; 11 yrs. planted; 86 ft. high. California.

DD. *Growth slow.*

Gleditsia triacanthos.
Liriodendron Tulipifera.
Tilia americana.
Tilia europæa.

CC. *Evergreen.*

D. *Palms and bananas.*

Erythea edulis.
Livistona australis.
Musa Ensete.
Trachycarpus excelsus.
Washingtonia filifera.
Washingtonia robusta.

DD. *Evergreen trees other than palms and bananas.*

Acacia elata.
Acacia melanoxylon.
Angophora intermedia.
Angophora subvelutina.
Eucalyptus amygdalina var. angustifolia.
Eucalyptus calophylla.
Eucalpytus cormybosa.
Eucalyptus ficifolia.
Eucalyptus polyanthemos.
Eucalyptus rudis.
Eucalyptus sideroxylon var. pallens.
Ficus macrophylla.
Syncarpia laurifolia.
Tristania conferta.
Umbellularia californica.

BBB. *For avenues and boulevards without sidewalks or with wide spaces between sidewalk and driveway.*

For this purpose almost any of the larger and more ornamental species enumerated in the other lists may be selected. Spreading coniferous trees, with broad bases (such as *Sequoia gigantea*, etc.), may often be used to advantage, as well as the wide-spreading feather-palms (Phœnix and Jubæa).

AA. *For country roads.*

B. *Deciduous.*

Acer campestre.
Acer macrophyllum.
Acer Negundo.
Acer Negundo var. californicum.
Acer platanoides.
Acer saccharinum.
Æsculus carnea.
Æsculus Hippocastanum.
Carya (Pecan).
Ginkgo biloba.
Juglans californica.
Juglans Sieboldiana.
Liriodendron Tulipifera.
Paulownia tomentosa.
Phytolacca dioica.
Populus nigra var. italica.
Quercus lobata.
Quercus pedunculata.
Robinia Pseudacacia.
Sophora japonica.
Taxodium distichum.
Tilia americana.
Tilia europæa.
Ulmus campestris.
Ulmus racemosa.

BB. *Evergreen.*

Acacia melanoxylon.
Acacia decurrena var. dealbata.
Arbutus Menziesii.
Cinnamomum Camphora.
Cryptomeria japonica.
Eucalyptus botryoides.
Eucalyptus calophylla.
Eucalyptus capitellata.
Eucalyptus cornuta.
Eucalyptus diversicolor.
Eucalyptus leucoxylon.
Eucalyptus rostrata.
Eucalyptus rudis.
Eucalyptus viminalis.
Ficus macrophylla.
Olea europæa.
Pinus radiata.
Quercus Suber.
Schinus Molle.
Sequoia gigantea.
Sequoia sempervirens.
Sterculia diversifolia.
Tristania conferta.
Umbellularia californica.

7. *Trees that have been tried in California but have proved unsatisfactory.*

There are many species that have failed to give satisfaction in some localities because of peculiarities of climate or soil; there are some, also, that have proved unsatisfactory on account of habit; from among these may be mentioned:

Acacia species. Nearly all acacias stump-sprout badly, so that for temporary planting they should be avoided. When planted in narrow parkings, they are very likely to raise sidewalks also, but this can be remedied by frequent root-prunings, which they stand admirably.

Acacia melanoxylon is generally debarred from the citrus belt as a breeder of scale: when mature it is said to suffer quickly from the effects of drought. In the moister climate of the immediate vicinity of the coast, near San Francisco, however, it proves entirely satisfactory.

Ailanthus altissima, has a bad reputation on account of its disagreeable odor, but as this is found only in the staminate trees, it can be avoided by planting none but the pistillate (fruit-bearing) trees.

Cratægus species. Of all these species, *C. Oxyacantha* is perhaps the one most commonly used, and through the Santa Clara Valley and Bay regions is disfigured,

in most cases, by sooty mold fungus, resulting from scale infestations. This can of course be remedied, but, in the average case, at considerable more expense than would be warranted.

Eucalyptus corynocalyx becomes straggling and unsightly with age.

Eucalyptus globulus and, in fact, almost all species of the genus, are frequently debarred by town ordinance from growth within 60 or even 70 feet of a sewer, on account of the remarkable length and penetrating power of their roots.

Eucalyptus robusta, a species which is exceedingly handsome as a young tree, has been extensively planted along roadsides and streets in the warmer parts of the state. When mature, it becomes straggling and exceedingly brittle, breaking up in an unsightly way.

Eucalyptus rudis. This species has a pendent habit when older that often causes a severe splitting of the crown. As the trees are very picturesque, they are often desirable, provided reasonable attention can be given to prevent this.

Ficus macrophylla is injurious to sidewalks.

Grevillea robusta has brittle wood and is usually much broken in heavy winds, but can be used with satisfaction if kept well cut back.

Melia Azedarach var. *umbraculiformis* is unsatisfactory in the immediate vicinity of the coast; as a sidewalk tree it is exceedingly untidy when losing leaves, and is also very much subject to scale insects.

Paulownia tomentosa is sometimes objected to on account of the somewhat untidy appearance of the persistent seed-pods, which require no little labor if all are to be removed after flowering.

Phœnix dactylifera and *P. reclinata* both sucker objectionably.

Populus alba, *Robinia Pseudacacia* and *Ulmus racemosa* are exceedingly troublesome when used as sidewalk trees on narrow streets; their surface roots often break the cement or asphalt sidewalks, and the suckers come up in the midst of lawns several yards away from the parent tree.

Schinus Molle should be avoided in the citrous belt, as it is found to harbor and become a nursery for scale insects. As a street tree it is also unsatisfactory, becoming too large and straggling, and requires too much pruning to keep it within bounds; its large surface roots often break cement and asphalt sidewalks.

The species of Phœnix and Jubæa should be avoided on account of their low, wide-spreading habit, except for avenues and boulevards where there is no sidewalk or where there is from 20 to 30 feet space between sidewalk and driveway.

8. *Trees for alkali soils.*

There are many places in those parts of the state that enjoy a high temperature and low rainfall, where the percentage of alkali salts in the soil is too great for the cultivation of most of our ornamental trees, and where it is very important that some shade-producing species be grown.

A. *Tolerant of strong "black" alkali (sodium carbonate).*

The most alkali-tolerant tree of those yet tested is *Kœlreuteria paniculata*, a small species 15 to 30 feet high, with feathery, pinnate leaves and ornamental yellow blossoms.

AA. *Tolerant of medium alkali (chiefly "white" alkali).*

Acacia melanoxylon.
Ailanthus altissima.
Albizzia lophantha.
Casuarina equisetifolia.
Eucalyptus amygdalina var. angustifolia (apparently the least sensitive of the eucalyptus).
Eucalyptus rostrata (Fig. 360).
Eucalyptus sideroxlyon var. rosea.
Phœnix dactylifera.
Platanus orientalis.
Populus Fremontii.
Quercus lobata.
Robinia Pseudacacia.

AAA. *Only fairly tolerant.*

Acer macrophyllum.
Acer Negundo var. californicum
Cinnamomum Camphora.
Gleditsia triacanthos.
Ulmus species.
Washingtonia filifera.

AAAA. *Tested and found unsuitable.*

Most of those trees of the humid regions, e.g., the eastern states and northern Europe, which have been tried on alkali soils, have been found to suffer and to remain dwarf and stunted. This is particularly true of *Liriodendron Tulipifera*, *Quercus pedunculata* and species of Tilia.

Since writing the above, the following additional information on the alkali tolerance of ornamental trees has been secured through the investigations of R. H. Loughridge of the Agricultural Experiment Station at Berkeley, and has been placed at our disposal.

Total amount of salts found in the upper 4 feet of soil in which the following trees were growing, expressed in tons per acre:

	Tons per acre in depth of 4 feet.
Kœlreuteria paniculata	32
Platanus orientalis	21½
Eucalyptus amygdalina	20
Eucalyptus angustifolia	20
Washingtonia (species not stated)	7½
Phœnix dactylifera	5
Cinnamomum Camphora	3½

Jos. Burtt Davy.
B. Y. Morrison.†

ARBOR VITÆ: *Thuja.*

ÁRBUTUS (ancient Latin name). *Ericàceæ*. Ornamental woody plants grown for their handsome evergreen foliage and for their attractive flowers and fruits.

Trees or shrubs with the bark of the branches and younger sts. smooth, and usually red, exfoliating: lvs. alternate, petioled, serrate or entire: fls. monopetalous, globular or urn-shaped, 5-toothed; stamens 10, included; anthers with a pair of reflexed awns, the cells opening by a terminal pore; ovary 5-, rarely 4-celled, cells with many ovules: fr. a globose, many-seeded, berry-like drupe with mealy flesh, mostly granulose outside.—Twelve species in W. N. and Cent. Amer., S. and W. Eu., Asia Minor, N. Afr., and Canary Isls.

The stems and branches are conspicuous by their red smooth bark peeling off in large thin plates, the evergreen foliage, rather large and usually lustrous flowers, white to red, in terminal panicles followed by attractive red fruits. They are of great decorative value for parks and gardens in warm-temperate regions; especially beautiful when adorned with the clusters of white flowers or bright red berries.

Arbutuses grow best in well-drained soil in somewhat sheltered positions not exposed to dry winds. They are very handsome greenhouse shrubs, thriving well in a sandy compost of peat and leaf soil or light loam.

Propagation is by seeds sown in early spring or in fall, or by cuttings from half-ripened wood in fall, placed in sandy peat soil under glass; they root but slowly. Increased also by budding or grafting, usually veneer-grafting, if seedlings of one of the species can be had for stock. Layers usually take two years to root.

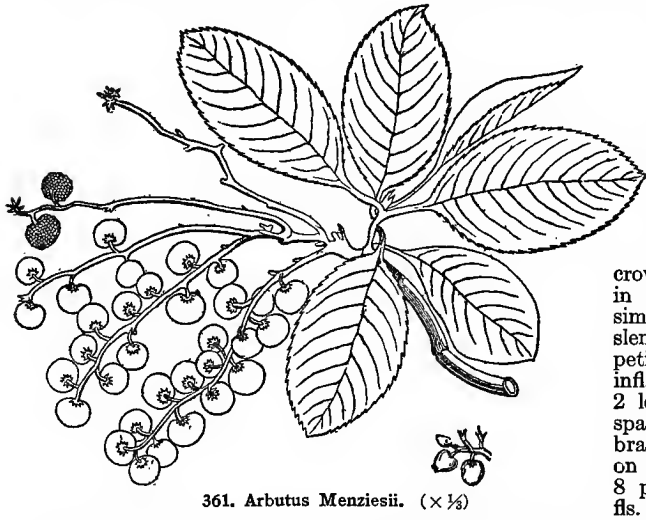
A. *Panicles short, nodding: lvs. usually serrate.*

Unèdo, Linn. Strawberry Tree. From 8–15 ft.: lvs. cuneate, oblong or oblong-lanceolate, 2–3 in. long, glabrous, green beneath: fls. white or red, ovate: fr. scarlet, warty, ¾in. broad. Sept.–Dec. S. Eu., Ireland. L.B.C. 2:123. R.B. 31:36. G.C. III. 14:329. Var. **integérrima**, Sims. Lvs. entire. B.M. 2319. Var. **rùbra**, Ait., and var. **Croòmii**, Hort., have red fls. Gn. 26, p. 506; 33, p. 320. F.S.R. 2, p. 375.—Very beautiful in autumn when the tree bears its large scarlet frs. and at the same time its white or rosy fls. Roots and lvs. astringent.

AA. *Panicles erect: lvs. usually entire.*

Ménziesii, Pursh (*A. procèra*, Douglas). Madrona. Fig. 361. Occasionally 100 ft. high; trunk with dark

reddish brown bark: lvs. rounded or slightly cordate at the base, oval or oblong, 3–4 in. long, glabrous, glaucous beneath: fls. white, in 5–6-in.-long panicles: fr. bright orange-red, ½in. long. Spring. W. N. Amer. B.R. 21: 1753. S.S. 5:231. P.M. 2:147. G.F. 3:515; 5:151. Mn.



361. Arbutus Menziesii. (×⅛)

3:85. B.M. 8249. R.H. 1893, pp. 149, 150.—The hardiest and probably the handsomest species of the genus; it stands many degrees of frost. Fig. 361 is adapted from Pacific Railroad Rept.

arizónica, Sarg. (*A. xalapénsis* var. *arizónica,* Gray). Fig. 362. Tree, 40–50 ft.: trunk with light gray or nearly white bark: lvs. usually cuneate at the base, oblong-lanceolate, 1⅓–3 in. long, glabrous, pale beneath: fls. white, in loose, broad panicles 2–3 in. long: fr. globose or oblong, dark orange-red. Spring. Ariz. G.F. 4:318 (adapted in Fig. 362). S.S. 5:233.—The contrast between the white bark of the trunk, the red branches, and the pale green foliage makes a very pleasant effect: fr. and fls. are also very decorative.

A. Andrachne, Linn. From 10–30 ft.: lvs. oval-oblong, usually entire, yellowish green beneath: fls. yellowisb white: fr. bright red. Greece, Orient. B.M. 2024. B.R. 2:113. G.C. III. 4:724. R.H. 1911, p. 307 (habit).—*A. andrachnoides,* Link (A. Andrachne × Unedo. A. hybrida, Ker. A. serratifolia, Lodd. A. Milleri, Hort. A. photiniæfolia, Hort.). Lvs. serrate: panicles drooping; fls. white. B.R. 8:619. L.B.C. 6:580. G.C. II. 9:211. F. 1879, p. 50. —*A. canariénsis,* Lindl. Height 10–30 ft.: lvs. oblong-lanceolate, serrate, glaucous beneath: panicles erect; fls. greenish white. Canary Isls. B.M. 1577.—*A. densiflòra,* HBK. Height 20 ft.: lvs. oblong or ovate, serrate, downy beneath: fls. white. Mex.—*A. hybrida,* Ker=A. arachnoides.—*A. laurifòlia,* Hook.=A. Menziesii.—*A. laurifòlia,* Lindl.=A. xalapensis.—*A. Milleri,* Hort.=A. andrachnoides.—*A. móllis,* HBK. Shrub or small tree: lvs. oblong, serrate, pubescent beneath: fls. white, often tinged greenish red. Mex. B.M. 4595.—*A. pilòsa,* Grah.=Pernettya pilosa.—*A. procèra,* Douglas=A. Menziesii.—*A. serratifòlia,* Lodd., not Salisb. =A. andrachnoides.—*A. texàna,* Buckl.=A. xalapensis.—*A. tomentòsa,* Pursh=Arctostaphylos tomentosa.—*A. Uva-úrsi,* Linn.= Arctostaphylos Uva-ursi.—*A. xalapénsis,* HBK. (A. laurifolia, Lindl.). Height 10–20 ft.: lvs. oval or ovate-lanceolate, entire or crenately serrate, glabrous or downy beneath: fls. reddish; corolla abruptly contracted above the middle. Mex., Texas. S.S. 5:232. B.R. 25:67.

ALFRED REHDER.

ARBUTUS, TRAILING: *Epigæa repens.*

ARCHANGÉLICA (Greek, *chief angel,* from fancied medicinal virtues). *Umbellíferæ.* GARDEN ANGELICA. A genus of 15–20 species of strong-smelling coarse herbs closely allied to Angelica, but differing in highly technical characters associated with the oil-tubes in the fruit.

officinàlis, Hoffm. A European and Asian biennial or perennial, known also as *Angelica Archangelica;* stout herb, with ternately decompound lvs. and large umbels of small fls.—The sts. and ribs of the lvs. were once blanched and eaten, after the manner of celery, and they are still used in making of sweetmeats. Little known in this country, although it is offered by American dealers. Its chief value to us is its large foliage. Seeds may be sown in the fall as soon as ripe, or the following spring. They are slow to germinate. Root used for its aromatic and carminative properties.

ARCHONTOPHŒNIX (Greek, *majestic phœnix*). *Palmàceæ,* tribe *Arèceæ.* Showy and elegant palms, completely spineless, and with tall stout trunks, which are conspicuously ringed by the annular scars of the fallen leaves.

Leaves divaricate, terminal, forming a large crown, pinnately divided, the segms. entire or toothed; in very young specimens the lvs. are undivided or simply bipartite; midrib prominent, the nerves more slender; rachis keeled above, convex beneath, the petiole slightly tomentose, and channeled above: infl. appearing much below the lvs., consisting of 2 long, flattened, ultimately pendent and deciduous spathes, inclosing the short-peduncled and much-branched, pedulous spadices: fls. monœcious, sessile on the branches of the spadix; in male fls. the 8 perianth segms. are unique in the family; female fls. with 3 perianth segms., sometimes more: fr. a drupe, globose or elliptic-globose, containing a single fibrous seed.—There are about 10 species, all natives of the Australian or Malayan region. G.C.II. 22:427.

As *Seaforthia elegans,* the second species is well known to all florists and decorators as one of the most graceful and stately palms in cultivation. Both species have become very popular in California for outdoor cultivation (see G. C. III. 27:109), where the second species fruits, seeds and germinates readily.

362. Arbutus arizonica. (×½)

In the North, they are grown in a temperate house, in a rich soil containing a good percentage of fibrous material and sand mixed with an equal part of rich loam. They require plenty of water.

Propagation is by seeds, which sprout readily in pans or boxes if placed in a warm moist house.

A. *Lf.-segms. whitish underneath.*

Alexándræ, H. Wendl. & Drude (*Ptychosp'rma Alexándræ*, F. Muell.). Trunk 70–80 ft.: lvs. several ft. long; rachis very broad and thick, glabrous or slightly scurfy; segms. numerous, the longer ones 1½ ft. long, ½–1 in. broad, acuminate and entire or slightly notched, green above, ashy glaucous beneath: infl. about 1 ft. long, the fls. greenish yellow: fr. ovoid-globular. Queensland. F.S. 18:1916.—Seldom ripening fr. on plants cult. outdoors in Calif. and rather tender when young

AA. *Lf.-segms. green on both sides.*

Cúnninghamii, H. Wendl. & Drude (*Ptychospérma Cúnninghamii*, H. Wendl. *P. élegans*, Blume. *Seafórthia élegans*, Hook.). Trunk and general habit like the preceding, but the segms. acuminate and entire or scarcely notched: fls. shell-pink, followed by globular berry-like drupes. Queensland and New S. Wales. B.M. 4961, 7345, the first as *Seaforthia elegans*, the second as *Ptychosperma elegans*.—Hardier than the preceding, and fruiting freely in outdoor specimens in Calif.

N. Taylor.†

ÁRCTIUM (from Greek word for *bear*, probably alluding to the shaggy bur). *Compósitæ.* Burdock. A few coarse perennials or biennials of Temp. Eu. and Asia, some of them widely distributed as weeds. Involucre globular and large, with hooked bristles, becoming a bur: receptacle densely setose: pappus deciduous, of short serrulate scales: lvs. alternate, large and soft, whitish beneath: plant not prickly: fls. pinkish or purplish in summer.

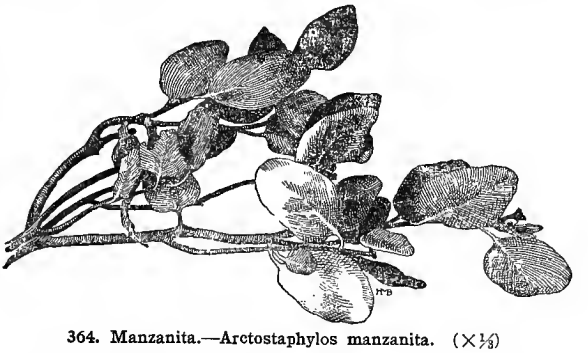
Lâppa, Linn. (*Lâppa màjor*, Gaertn.). Common Burdock. The burdock is a common and despised weed in this country, although it is capable of making an excellent foliage mass and screen. In Japan it is much cult. for its root, which has been greatly thickened and ameliorated, affording a popular vegetable. It is there known as gobo (see Georgeson, A. G. 13, p. 210). Roots collected from plants of the first year's growth are used as an alterative in blood and skin diseases. The seeds and fresh lvs. are used medicinally to a limited extent. *A. mìnus*, Schk., a European weed, widely naturalized in E. N. Amer. is apt to be confused with *A. Lappa*. N. Taylor.†

363. Arctostaphylos Uva-ursi. (×⅓)

ARCTOSTÁPHYLOS (Greek, *bear* and *grape*). *Ericàceæ.* Manzanita. Ornamental shrubs grown for their evergreen foliage and also for their attractive flowers and fruits.

Shrubs or rarely small trees: lvs. alternate, entire, evergreen: fls. small in terminal often panicled racemes; calyx 4–5-parted, persistent; corolla urceolate, 4–5-toothed; stamens 8 or 10, included; anthers with a pair of awns, the cells opening with a pore; ovary 4–10-celled, 1 ovule in each cell: fr. a red, usually smooth mealy berry or rather drupe with 4–10 coherent nutlets.—About 20 species in N. and Cent. Amer., 1 species also in N. Eu. and N. Asia. Includes Comarostaphylis.

They are handsome evergreen shrubs, though generally with less conspicuous flowers and fruits than those of the allied genus Arbutus. Some Central American species, however, as *A. arbutoides*, *A. arguta* and *A. polifolia* are beautiful in flower, and well worth a place in the greenhouse or in the garden in temperate regions; of the American species, *A. Pringlei*, *A. viscida* and *A. bicolor* are some of the handsomest. Only the trailing species are hardy North. For culture, see *Arbutus*.



364. Manzanita.—Arctostaphylos manzanita. (×⅓)

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A. *Trailing or creeping: lvs. ½–1½ in. long: fls. in short and rather few-fld. clusters.*

1. **Uva-ursi,** Spreng. (*Árbutus Úva-úrsi*, Linn.). Bearberry. Fig. 363. Lvs. obovate-oblong, tapering into the petiole, retuse or obtuse at the apex: fls. small, about ¼in. long, white tinged with red. Northern hemisphere, in N. Amer. south to Mex. Em. 2:431. Gn. 14:68 (habit).—Hardy trailing evergreen shrub, like the following valuable for covering rocky slopes and sandy banks. Cuttings from mature wood taken late in summer root readily under glass. Lvs. are employed in medicine chiefly for their action on the kidneys and bladder.

2. **nevadénsis,** Gray (*A. californica*, Hort.). Lvs. obovate or obovate-lanceolate, abruptly petioled, acute or mucronate at the apex: fls. in short-stalked clusters, white or tinged with red. Calif., in the higher mts. G.W. 13:326 (habit).

AA. *Erect shrubs: lvs. usually 1–2 in. long: fls. in mostly many-fld. panicled racemes.*

B. *Lvs. glabrous, rarely minutely pubescent.*

C. *Pedicels glabrous.*

3. **púngens,** HBK. From 3–10 ft.; glabrous or minutely pubescent: lvs. slender-petioled, oblong-lanceolate or oblong-elliptic, acute, entire, green or glaucescent: fls. in short, umbel-like clusters: fr. glabrous, about ¼in. broad. Mex., Low. Calif. B.R. 30:17. B.M. 3927.

4. **manzanìta,** Parry (*A. púngens*, Authors). Fig. 364. Shrub or small tree, to 30 ft.. lvs. ovate, usually obtuse and mucronulate at the apex, glabrous, dull green: fls. in prolonged panicled racemes: fr. glabrous, ¼–½in. broad. W. N. Amer., from Ore. south. G.F. 4:571. G.C. III. 44:163. B.M 8128.

CC. *Pedicels glandular.*

5. **glaûca,** Lindl. From 8–25 ft.. lvs. oblong or orbicular, obtuse and mucronulate at the apex, glaucescent or pale green: fls. in prolonged panicled racemes; pedi-

cels glandular: fr. minutely glandular. Calif.—Intro. 1891. Lvs. used medicinally like those of *A. Uva-ursi.*

6. víscida, Parry. From 5–15 ft.: lvs. broad-ovate or elliptic, abruptly mucronulate, acute or rounded at the base, glaucous: fls. in slender and spreading, panicled racemes; pedicels viscid; corolla light pink: fr. depressed, about ¼in. broad, smooth. Ore. to Calif.

BB. *Lvs. more or less pubescent.*

C. *Branchlets usually bristly-hairy: lvs. dull grayish or bluish green above.*

7. tomentòsa, Douglas. From 2–6 ft.: lvs. oblong-lanceolate or ovate, acute, sometimes serrulate, pubescent beneath, pale green: fls. in rather dense and short, usually panicled racemes; pedicels short: fr. puberulous, glabrous at length. W. N. Amer. B.R. 21:1791. B.M. 3320.—The hardiest of the erect species.

365. Arctotis grandis. (×⅓)

8. **Príinglei,** Parry. Shrub: lvs. broad-ovate or elliptic, usually abruptly mucronulate, pubescent, sometimes glabrous at length, glaucous: panicled racemes peduncled, usually leafy at the base, many-fld.; slender pedicels and calyx glandular-pubescent: fr. glandular hispid. Calif., Ariz.

CC. *Branchlets tomentose: lvs. bright green and lustrous above.*

9. **bícolor,** Gray. From 3–4 ft.: lvs. oblong-oval, acute at both ends, entire and revolute at the margin, glabrous and bright green above, white-tomentose beneath: fls. in nodding, rather dense racemes; pedicels and calyx tomentose; corolla ⅓in. long, rose-colored: fr. smooth. Calif.

10. **diversifòlia,** Parry (*Comarostáphylis diversifòlia,* Greene). Shrub, 5–15 ft.: lvs. elliptic or ovate to oblong, 1–2½ in. long, acute, cuneate at the base, spinulose-dentate, often revolute at the margin, grayish pubescent or tomentose beneath: racemes terminal, usually several, 1½–4 in. long, tomentose; pedicels slender; corolla ¼in. long, light pink: fr. ovoid, ¼in. long, scarlet. Low. Calif. May, June: fr. in Aug., Sept. Mn. 5:231.

A. alpina, Spreng.=Arctous alpina.—*A. arbutoìdes,* Hemsl. Five to 6 ft.: lvs. lanceolate, oblong, ferrugineously pubescent beneath: panicles erect, loose. Guatemala. B.R. 29:30.—*A. argùta,* Zucc. (A. nitida, Benth.). Five to 6 ft.: lvs. oblong-lanceolate, serrate, glaucous and glabrous: panicles loose, erect. S. Mex. B.R. 31:32. B.M. 3904 (as A. nitida).—*A. califórnica,* Hort.=A. nevadensis.—*A. nítida,* Benth.=A. arguta.—*A. polifòlia,* HBK. Height 1–3 ft.: lvs. linear-lanceolate, glaucous and puberulous beneath: fls. red, in loose, erect racemes. Mex.

ALFRED REHDER.

ARCTÒTIS (Greek for *bear's ear,* alluding to the achene). *Compósitæ.* Herbs with long-peduncled heads and more or less white-woolly herbage, of 30 or more African species: achenes grooved, with scale-like pappus: involucre with numerous imbricated scales: receptacle bristly.—Two species, both treated as annuals, are sold in this country. Cultivation simple.

breviscàpa, Thuub. (*A. leptorhìza* var. *breviscàpa,* DC.). Stemless or nearly so (6 in. high), half-hardy, readily prop. from seeds, and to be grown in a warm, sunny place: lvs. usually longer than the scape, incised-dentate: scape hirsute, bearing one large fl. with dark center and orange rays.

grándis, Thunb. Fig. 365. A beautiful annual, forming a bushy clump 2–2½ ft. high: lvs. much shorter than the scape, repand dentate: fls. 2½–3 in. diam., white or white and pale violet.—May be the same as *A. stœchadifolia,* Berger.

A. Gúmbletonii, Hook. f. Ray fls. deep orange-red. Namaqualand, S. Afr. B.M. 7796.

N. TAYLOR.†

ARCTÒUS (Greek, *boreal,* referring to its distribution). Syn. *Mairània. Ericàceæ.* Ornamental flat shrub, rarely cultivated in rockeries for its bright green foliage and scarlet or black fruits in autumn.

Prostrate glabrous shrub: lvs. alternate, serrate, deciduous: fls. in small terminal racemes; calyx 4–5-parted; corolla urceolate with 4–5-toothed recurved limb; stamens 8–10, included, anthers with a pair of short awns, cells opening with a pore; ovary 4–5-celled: fr. a globose juicy drupe with 4–5 separate nutlets.—One circumpolar species.

This is a plant lying flat on the ground, with shreddy bark, thin deciduous leaves clustered toward the end of the branches, small white flowers appearing before or with the leaves, followed by lustrous, black or red fruits. Adapted for rockeries where it will probably succeed best in peaty soil and in a half-shady position. Propagation is by seeds and by cuttings.

alpìnus, Niedenzu (*Arctostáphylos alpìna,* Spreng. *Mairània alpìna,* Desv.). Lvs. obovate or oblanceolate, narrowed into the short petiole, ½–1½ in. long, reticulate, serrate: fls. 2–4, ½in. long, white tinged pinkish or greenish: fr. ⅓in. across, globose, bluish black. N. Amer., N. Eu., and N. Asia. S.E.B. 6:880. B.B. 2:573. M.D.G. 25:138 (habit). Var. **rùber,** Rehd. & Wilson. Fr. bright red, not changing to black. Rocky Mts., W. China.—This variety is handsomer than the type on account of the bright color of the fr.

ALFRED REHDER.

ARDÍSIA (*pointed,* alluding to the stamens or corolla-lobes). Including *Icacòrea. Myrsinàceæ.* Trees and shrubs, some of which are grown in their juvenile state as pot subjects, or as outdoor specimens in warm climates.

Flowers white or rose, usually in cymes, with 5-parted (sometimes 4- or 6-parted) rotate corolla, 5 stamens attached to the throat of the corolla, with very large anthers and a 1-seeded drupe the size of a pea: lvs. entire, dentate or crenate, thick and evergreen.—Probably more than 200 species in the tropical and subtropical parts of both hemispheres, one of which (*A. crenulata*) is a popular berry-bearing conservatory

and table plant, and a half-dozen others of which are sometimes seen in collections.

Ardisia crenulata is in great demand as a Christmas plant. The other species are seldom seen in this country. They are nearly always propagated from seed, but a plant can be secured more quickly, and better, from a cutting. When plants are over three years old, they often lose their foliage and become "leggy." Good plants can be obtained from the bushy tops by girdling them near the branches, and covering the pieces from which the bark has been removed with wet moss; the moss will be well filled with root in about six weeks, when the tops may be taken off and potted, keeping them in a tight case until they grip the soil. These plants, from which the tops have been removed, are excellent material from which to obtain cuttings, and they will break quite readily if placed in a close, warm atmosphere, about 65°. Cuttings should be taken from young shoots of half-matured wood, and placed in a cutting-bed with a top and bottom temperature of 70°. If these conditions are followed they will root in a month, after which they may be transferred to small pots. Loam, peat and sand in equal parts is the best potting material. As the plant increases in size and vigor, decomposed manure should be added to the mixture, about a fourth part of manure being sufficient. A night temperature of 65° should be maintained for securing the best results.—The advantage of the cutting over the seedling will be apparent, the cutting branching near the pot, whereas the seedling will grow a few inches of stem first. Care should be exercised in selecting the plants from which to propagate, since those grown from seed will vary somewhat in the size and number of berries they produce, and only the best should be selected as stock plants. As soon as the plants show signs of flowering, they should be given more air, and wetting overhead should be avoided until the berries are set. They should at all times be kept in a light position near the glass; during the summer months, however, they should be shaded with cheese-cloth on bright sunny days. About the 1st of October, the berries will be well developed and should be given plenty of sunshine to color them well. The temperature may be lowered to 50° or 55°, as growth is not wanted at this season. Waterings with soot-water will be beneficial, a handful to an ordinary watering-pot. This produces a fine color on the leaves and berries.—The large brown scale is the greatest enemy of this plant; and the best means to keep this in check is to fumigate with cyanide of potassium. Several fumigations will effect a cure. The temperature of the house should never be over 60° when fumigated. (Geo. F. Stewart.)

A. *Fls. red or rose-colored.*

crenulàta, Lodd. (*A. crenàta,* Sims. *A. crispa,* Hort.). Fig. 366. As cult., a compact and neat shrub, with lance-oblong, wavy-margined, alternate lvs. and drooping clusters of small coral-red, long-lasting, handsome frs: fls. in terminal panicles, sweet-scented. Probably native to E. Indies or China. B.M. 1950. L.B.C. 1:2. Mn. 1:58. A.F. 13:558. Var. **variegàta,** Hort., has variegated lvs.

hùmilis, Vahl. Lvs. lance-oblong, shining: frs. shining black. India.

Ôliveri, Mast. Lvs. nearly sessile, recurved, oblanceolate and acuminate, 6–8 in. long, entire: fls. pink, in large, dense heads, like an ixora, the limb rotate, ½in. across. Costa Rica. G.C. II. 8:681.—Elegant stove plant.

AA. *Fls. white.*

japónica, Blume. Lvs. short-oblong or somewhat cuneate, whorled, serrate: fls. on red pedicels in drooping racemes: berries white. Dwarf. Japan.—Probably hardy in the N.

polycéphala, Wall. Lvs. bright green, red or wine-colored when young, opposite: fr. black. E. Indies.

AAA. *Fls. purple or black-dotted.*

Pickerìngia, Torr. & Gray (*Icacòrea paniculàta,* Sudw.). MARBLEBERRY. Glabrous, to 24 ft.: lvs. oblanceolate to lance-oblong, entire, narrowed to a petiole: panicle many-fld.; corolla-lobes oval and becoming reflexed: fr. as large as peas, black and shining. E. Fla. Intro. 1891.

A. umbellàta is offered in this country as coming from India. The *A. umbellàta,* Baker (of the botanists), is a Madagascar plant, and it is doubtful whether it is cult. in this country. Species with white fls. are *A. acuminàta,* Willd., B.M. 1678; *A. capitàta,* Gray; *A. mamillàta,* Hance; *A. punctàta,* Roxbg.; *A. villòsa,* Wall. Species with red or reddish fls. are *A. macrocárpa,* Wall.; *A. paniculàta,* Roxbg., B.M. 2364; *A. serrulàta,* Swartz; *A. Wállichii,* DC. Recently described ardisias are: *A. gigantifòlia,* Stapf., with elliptic lvs. 12–14 in. long and 8 in. broad: fls. small, rose-colored, in long-stalked loose panicle. S. China. *A. Brandneriàna,* Linden, dwarf, with green-shaded crenulate lvs. Congo. L. H. B.

366. Ardisia crenulata. (×½)

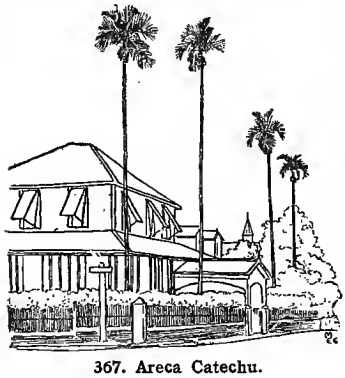
ARÈCA (said to be latinized form of Malayan name). *Palmàceæ,* tribe *Arèceæ.* A graceful and well-known group of spineless palms, the trunks solitary or forming a ring-like clump.

Leaves at first bipartite, and only after several years forming the beautiful and gracefully pinnate adult lvs., which form large terminal clusters; lfts. slender, lanceolate or linear, acuminate; rachis 3-angled, convex on the back, the upper face and the petiole concave: spadix very much branched, appearing from the lowest lf.-base, and by the falling of this ultimately being separated from the lf.-cluster; spathes 3, 1 inclosing the fls., the other 2 usually bract-like: fls. monœcious, the female solitary, surrounded by numerous slender spikes of male fls. which are fragrant and white, and much smaller than the female: fr. ovoid, orange-colored, surrounded by the persistent, coriaceous perianth.—There are only about 14 species, confined to the Asiatic and Australian tropics, all the 30 or more species usually credited to the genus belonging in Acanthophœnix, Chrysalidocarpus (*A. lutescens*), Dictyosperma, Eutorpe, Hyophorbe, Kentia (Howea), Oncosperma, Phœnicophorum and others. From Pinanga, the most closely related genus, Areca is distinguished by having not more than 6 stamens and by the female fls. being much larger than the male.

Areca is commercially a very important genus on account of the betel nut (*A. Catechu*). The fibrous spathes and the covering of the fruit are used in packing; the seeds contain a dye, and, most important of all, are the source of the masticatory "betel nut" of the East. Medicinally, their principal use is for expelling tape-

worms. More than seventeen varieties of the nut are known in India alone, where the trade in the nuts (seeds) exceeds $30,000,000 yearly. It is also used extensively for medicinal purposes.

The cultivation of arecas is not difficult. They must be grown in a tropical house with a day temperature of 75° to 85° and a night temperature of not less than 60°. Young plants thrive in a mixture of equal parts of peat or leaf-mold and loam, while older plants will do best in a mixture of loam and sand, equal parts, mixed with a liberal amount of well-rotted cow- or horse-manure. Water freely, at least every other day. As young plants, they form beautiful decorations and when old are perhaps the most graceful and delicately foliaged palms in cultivation. G.C. II. 22:427.



367. Areca Catechu.

A. *Sts. solitary and exceeding 40 ft. in adult trees.*

Cátechu, Linn. BETEL NUT. Fig. 367. St. solitary, 40–100 ft.: lvs. 4–6 ft., forming a large crown, but with 1 or 2 of the lowest usually pendulous; lfts. numerous, 1–2 ft., upper confluent, quite glabrous: spathe, flattened and, smooth in age, become fibrous when old: fr. 1½–2 in., ovoid, smooth, orange or scarlet. Asia and Malayan Isls.—Frequent in American tropics.

AA. *Sts. usually numerous, often forming a ring, usually not over 25 ft.*

B. *Young growth red: lfts. appearing in bunches of 3.*

Ilsemannii, Hort. Resembles a red-stemmed chrysalidocarpus: young lvs. very dark red, becoming green; fronds slender, arching, with curving pinnæ: fls. and fr. unknown. Oceanica (?). R.H. 1898:261. (as *Linospadix Micholtziana*).

BB. *Young growth green: lfts. not in bunches of 3.*

Álicæ, F. Muell. Sts. several from the same rhizome, 9 ft. or more high, and slender: lvs. 3–6 ft. long; segms. acuminate, several confluent, especially at apex, bright shining green on both sides: fls. paniculate, the panicle coming from between the lvs. Queensland.

tríandra, Roxbg. Trunk 15–25 ft. high, 1–2½ in. thick, usually several together, and frequently sending out basal offshoots, cylindrical: fronds 4–6 ft. long; segms. with 6 primary nerves about 1 line apart; petiole about 1 ft. long: fls. as in *A. Catechu*: fr. about as large as an olive, orange-scarlet. India.

A. álba, Bory=Dictyosperma alba.—*A. Baúeri,* Hook. f.= Rhopalostylis Baueri. B.M. 5735.—*A. elegantíssima,* Hort. Trade name(?).—*A. furfurácea,* Hort.=Dictyosperma furfuracea.—*A. gigantèa,* Hort.=Pinanga ternatensis.—*A. grácilis,* Roxbg.=Pinanga graciliis.—*A. grácilis,* Thouars=Dypsis pinnatifrons.—*A. grácilis,* Giseke=Drymophlœus appendiculatus.—*A. grandifórmis,* Hort.=Trade name(?).—*A. lutéscens,* Bory.=Chrysalidocarpus lutescens.—*A. madagascariénsis,* Mart. A rare species, with small trunk and few lvs. Madagascar.=Dypsis madagascariensis.—*A. monastàchya,* Mart.=Bacularia monostachya. B.M. 6644.—*A. montàna,* Hort. B.M. 3874 (as Euterpe).—*A. Nìbung,* Griff.= Oncosperma filamentosum.—*A. oleràcea,* Jacq.=Oreodoxa oleracea. —*A. pùmila,* Blume=Nenga Wendlandiana. B.M. 6025.—*A. rùbra,* Hort.=Dictyosperma rubra.—*A. rùbra,* Bory=Acanthophœnix rubra.—*A. Sanderiàna,* Hort. Trade name(?).—*A. sápida,* Soland.=Rhopalostylis sapida. B.M. 5139.—*A. speciòsa,* Hort. Trade name(?).—*A. tigillària,* Jack.=Oncosperma filamentosa.— *A. Verschaffèltii,* Hort.=Hyophorbe Verschaffeltii.

N. TAYLOR.

AREGÈLIA (named in honor of the botanist, C. von Regel). *Bromeliàceæ.* Epiphytic hothouse plants with the serrate lvs. arranged in a rosette: fls. in a simple dense head among the inner lvs. of the rosette, which are often colored, violet, blue or white.—A genus of about 25 species, inhabiting Guiana and Brazil. The species below are sometimes referred to Nidularum. For cult., see *Billbergia.*

A. *Length of fl. 1¼ in. or less.*

trístis, Mez (*Nidulàrium marmoràtum,* Hort., not Morr. *N. tríste,* Regel. *Karàtas trístis,* Baker). Lvs. 6–12, from 6–12 in. long and half as broad in the middle, green dappled with brown, somewhat scurfy beneath: fl. purple: bract-lvs. narrow-linear: fr. oblong, white.

AA. *Length of fl. 1½ in. or more.*

B. *Lvs. not barred.*

C. *The lvs. densely scaly.*

Morreniàna, Mez (*Karàtas Morreniàna,* Ant. *Nidulàrium Morreniànum,* Makoy). Lvs. many in a dense rosette, with few very minute spines, not striped, densely scurfy beneath: fls. many, dark purple: bract-lvs. linear-lanceolate.

CC. *The lvs. free from scales or nearly so.*

Carolìnæ, Mez (*Nidulàrium Carolìnæ,* Lem. *N. Mèyendorfii,* Regel. *Karàtas Carolìnæ,* Ant. *Guzmània pícta,* Hort. *Billbérgia Carolìnæ,* Beer. *B. òlens,* Hook.). Lvs. several to many, strap-shaped, rather thick, finely spiny-toothed, 12 in. long, bright green on both surfaces, the bract-lvs. bright red: fls. blue-purple, in a short head nestling in the bright lf.-cup. B.M. 5502. I.H. 7:245.

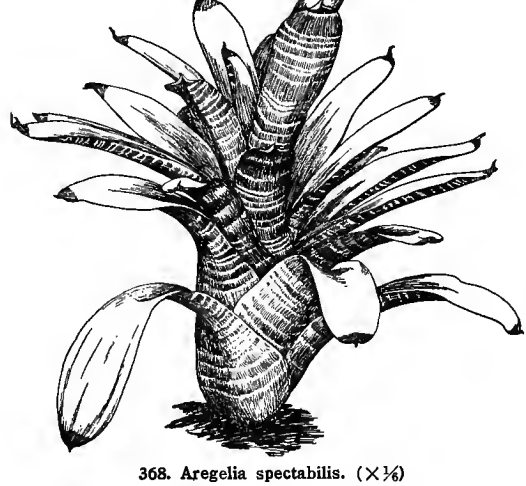
prínceps, Mez (*Nidulàrium prínceps,* Morr. *N. spectábile,* Hort. *Karàtas prínceps,* Baker. *K. Mèyendorfii,* Ant. *A. prínceps,* Mez.). Lvs. 15–20, about 10–12 in. long, broadest at the middle, firm, spiny-toothed, lightly glaucous: fls. numerous, violet-purple, surrounded by about 8–10 oval, bright red bract-lvs.

BB. *Lvs. conspicuously barred on the back.*

Binòtii, Mez (*Nidulàrium Binòtii,* Regel. *N. Makoyànum,* Regel. *Karàtas Binòtii,* Ant.). Lvs. 15–20, strong-spiny, scurfy and transversely banded on the back, the inner ones similar in color: fls. many, white. —Not to be confounded with *Bromelia Binotii.*

spectàbilis, Mez (*Karàtas spectàbilis,* Ant. *Nidulàrium spectàbile,* Moore. *N. exíminum,* Hort.). Fig. 368. Lvs. 10–15 in. long, about 1½ in. broad, serrulate, barred on the back, the apex rounded, apiculate, with a red apical spot: fls. milky, pale blue at the apex. Brazil. B.M. 6024.

GEORGE V. NASH.†



368. Aregelia spectabilis. (×⅙)

XI. Arboriculture.—A palm plantation, with Corypha umbraculifera in the foreground.

ARENÀRIA (*arena*, sand, where many of the species grow). Including *Alsine*, *Cherleria* and *Moehringia*. *Caryophyllàceæ*. Low herbs, mostly with white flowers, usually forming mats, and suitable for borders, carpets, and lawn clumps; many of them also used for rockwork and alpine gardens; spring- or summer-flowering.

Annual or perennial, with opposite entire narrow exstipulate lvs.: fls. small, terminal or clustered, or sometimes axillary; sepals 5; petals 4 or 5, entire or slightly notched, sometimes wanting; stamens 10 (rarely 8); styles mostly 3: fr. a small caps., opening by valves as many or twice as many as the styles.—Perhaps 130–150 species, as the genus is here defined, throughout the world but rare in the tropics. Only the perennial species are commonly cult. Of easiest cult. in almost any soil. Prop. by division; also by seeds, and rare species sometimes by cuttings. Many species of arenaria may be found in the collections of alpine-garden and rock-garden fanciers; but the prevailing cult. kinds are accounted for below Related genera are Cerastium and Stellaria. Monogr. by F. N. Williams, Journ. Linn. Soc. 33:326 (1897–8).

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A. *Petals usually wanting or rudimentary.*

1. **sedoìdes,** Froel. (*Cherlèria sedoìdes*, Linn.). Minute green moss-like carpeter, 1 or 2 in. high: fls. unisexual or polygamous, greenish, inconspicuous. Mts., Eu.—A choice rock-cover in alpine gardens. Prop. by division or seeds.

AA. *Petals usually present and prominent.*

B. *Fls. purplish.*

2. **purpurascens,** Ramond. Alpine, tufted and decumbent: lvs. ovate-lanceolate, acuminate: fls. on short tomentose pedicels, 2 or 3 on a branch, the purplish corolla exceeded by the sepals. Pyrenees.—A carpeter.

BB. *Fls. white (sometimes purple in No. 16).*

C. *Lvs. ovate-oblong or lanceolate.*

3. **baleárica,** Linn. Very low (3 in. high), creeping, with small ovate glossy thick and ciliated lvs.: fls. single on long peduncles; sepals erect. Balearic Isls., Corsica.—Not hardy in latitude of New York City.

4. **aretioìdes,** Portens. Densely cespitose, and making a good green carpet: lvs. oblong-lanceolate, obtuse and short-mucronulate, grooved above and 3-nerved beneath: fls. solitary, with 4 sepals.—High Alps.

5. **tetraquètra,** Linn. Carpeter, 3–6 in., pubescent: lvs. ovate, keeled, 4-rowed: fls. in heads, with sepals stiff and ciliate and nearly equaling petals. France.

6. **lanceolàta,** All. Cespitose-procumbent, the sts. ascending: lvs. lanceolate, rounded at base, acute, flat, many-nerved below: fls. 1–3, the sepals lanceolate-acute, equaling the petals. High Alps.

7. **macrophýlla,** Hook. Sts. decumbent and angled, pubescent: lvs. lanceolate or lance-oblong, mostly acute: peduncles slender, 1–5-fld., the sepals lanceolate-acuminate. Labrador and Vt. to the Pacific. Intro. 1881.

CC. *Lvs. linear or awl-like.*

D. *Sepals obtuse.*

8. **grœnlándica,** Spreng. Annual: very low, forming mats, the decumbent or erectish sts. bearing 1–5 fls.: lvs. linear and obtuse, ½in. or less long: sepals and petals blunt, the latter sometimes notched. High altitudes and latitudes, but coming to the seacoast in parts of New Eng., and ranging down the mts. to N. C. Intro. 1884.—A neat little alpine.

9. **graminifòlia,** Schrad. A foot or less high: lvs. long and filiform, rough-margined: fls. in 3-forked loose pubescent panicles; petals obovate, exceeding calyx. Eu.

DD. *Sepals acute, pointed or even awned.*

E. *Blossoms solitary, or mostly in 2's or 3's.*

10. **grandiflòra,** Linn. Fig. 369. Ten in. or less high: lvs. flat-awl-shaped, 3-nerved and ciliate, the radical ones crowded: fls. large, solitary or in about 2's or 3's, long-stalked. Eu.—Runs into many forms.

11. **montàna,** Linn. Smaller: lvs. linear or nearly so: fls. large, solitary, very long-stalked; sepals acuminate, less than the corolla. S. W. Eu.

12. **Rosànii,** Tenore. (*Alsine Rosànii*, Fenzl). Low (1–2 in.): lvs. linear-lanceolate and mucronate, hairy, striate: sts. erect, hirsute, about 3-fld.: fls. white, with obovate petals and striate longer sepals. Italy.

EE. *Blossoms 5–7 (or more) together.*

13. **pinifòlia,** Bieb. (*Alsìne pinifòlia* var. *grácilis*, Fenzl). Cespitose, the branches ascending: lvs. narrowly awl-shaped or bristle-like, often curved: fls. large, in 5–7-fld. corymb, the pedicels equaling the calyx or shorter; sepals linear, hairy, 3-nerved; petals obovate-oblong, exceeding calyx. Asia Minor.—A dwarf compact plant with small pine-like foliage which becomes rosulate on sterile shoots, producing many pure white fls.; an attractive edging and rockery plant.

369. Arenaria grandiflora. (×⅓)

14. **vêrna,** Linn. (*Alsìne vérna*, Bartl.). Dwarf, 1–3 in. high: lvs. linear-subulate, flat, strongly 3-nerved, erect: fls. on filiform peduncles, with strongly 3-nerved sepals. Eu. and Rocky Mts.—Excellent little rock plant. Var. **cæspitòsa,** Hort., is a compact, leafy form, making dense moss-like masses; all summer.

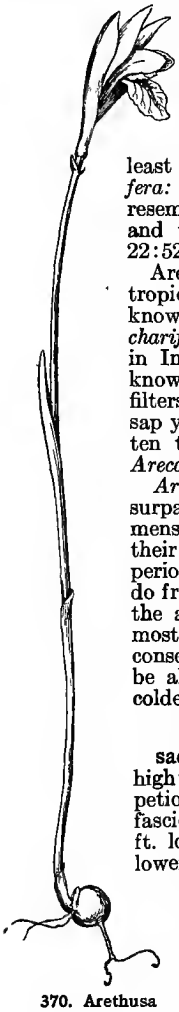
15. **juniperìna,** Linn. (*Alsìne juniperìna*, Fenzl. *A. juniperifòlia*, Hort.?). Cespitose, nodes often swollen: sts. simple, bearing clusters: lvs. awl-like, mucronate, keeled, about 1-nerved, often recurved and persisting: fls. with lanceolate-acuminate 3-nerved sepals, and longer linear-cuneate white petals. E. Eu. and Asia Minor.—Variable.

16. **aculeàta,** Wats. Sts. 4–6 in. high: lvs. stiff and sharp, glaucous: fls. fascicled, white, but often purple. W. Amer. Intro. 1889.

17. **Fránklinii,** Douglas. Sts. 3–5 in. high, nearly or quite glabrous: lvs. in 3–6 pairs, narrow-subulate, sharp-pointed: fls. in dense cymes at the top of the st. W. Amer. Intro. 1881. L. H. B.

ARÉNGA (derivation unknown). *Palmàceæ*, tribe *Arèceæ*. Tall, usually spineless palms with a thickish, ringed trunk, the upper part of which, and the leaf-stalks are often covered with long black fibers.

Leaves pinnate, the lfts. regularly placed on the rachis, sometimes confluent at their bases, the jagged or cut-off appearance of the lfts. peculiar to this genus and Caryota among the horticultural palms, the margin irregularly toothed above the middle; the lvs. paler beneath than above; petiole flattish or convex: fls. monœcious, numerous, and with 2 or more bracts beneath each sessile fl.; spadix 6–10 ft. long in some species, usually smaller, coming from among the lvs. and developing downwards; when the last fl.-cluster reaches maturity some at least of the species die, notably *A. saccharifera:* fr. the size of an apple and somewhat resembling it, containing 2 or 3 oblong and usually dark brown seeds. G.C. II. 22:522.



370. Arethusa bulbosa. (×½)

Arengas are graceful palms, all natives of tropical Asia and Australia, and so far as known are of only eight species. *A. saccharifera* is an important economic plant in India, the black fiber at the leaf-bases known as gomuta fiber being widely used for filters and in the caulking of ships. The sap yields "arenga sugar" after the plant is ten to twelve years old. For culture, see *Areca.*

Arenga saccharifera, in a young state, is surpassed in beauty by most palms. Specimens eight to ten years old, however, show their characteristics well, and from that period till they begin to flower (which they do from the top of the stem downwards in the axils of the leaves), they are among the most striking subjects for high and roomy conservatories. The temperature should not be allowed to fall below 55° F. during the coldest weather. (Oliver.)

A. *Trunks at least 20 ft. or more.*

saccharífera, Labill. Trunk 20–40 ft. high: lvs. very many, frequently 20–28; petioles smooth; lfts. 115, on each side, fasciculate, in 4's or 5's, linear-ensiform, 3–5 ft. long, 1- or 2-auricled at the base, the lower auricle the longer, 2-lobed or variously dentate at the apex, white or silvery beneath: branches of the spadix long, fastigiate, pendulous: male fls. purple, 1 in. long. Malaya.

obtusifólia, Mart. Trunk 20–30 ft. high, 1–1½ ft. thick: fronds 9–13, 12–16 ft. long; petiole thickly spiny, especially on the margins, scarcely more than 1 ft. long; segms. 1½ in. apart, 2–3 ft. long, 1½–2 in. wide, alternate, lanceolate-linear, unequally acutely dentate, attenuate, 2-auricled at the base, the lower auricle the larger, glaucous beneath: branches of the spadix short, lax, nodding. Java.

AA. *Trunks not over 10 ft.*

Éngleri, Becc. About 5 ft. tall: lvs. numerous, with a great many lfts. about 16 in. long and 1 in. wide, much constricted at the base and irregularly toothed at the apex: infl. much branched, borne among the lvs., not more than 1½ ft. long: fr. about ¾in. diam. Formosa.—Not as yet common in this country, but interesting among arengas for its small size.

A. Borréttii, Hort., reported from E. Indies, is a name frequently appearing in hort. literature, not certainly referable.

N. Taylor.†

ARETHÙSA (the nymph *Arethusa*). *Orchidàceæ.* Handsome terrestrial tuberous orchids.

Scapes leafless or with a single lf. 1- to few-fld.; fl. gaping, the sepals and petals nearly alike, arching over the column; lip erect, narrow, entire, adnate to the base of the elongated erect column, and produced into a short spur.—Three species, 2 in N. Amer. and 1 in Japan.

bulbòsa, Linn. Fig. 370. A very pretty hardy orchid, 8–10 in., with one linear, nerved lf. and a bright rose-pink fl. on an erect scape, the lip recurved and bearded. Bogs, N. C., N. and W.; not common. May, June. Mn. 5:141.—Requires a moist and shady, cool situation and open, porous soil. A shady nook on north slope of rockery, where it can be watered in dry weather, is an ideal place. Prop. is by the solid bulbs.

A. sinénsis, Rolfe. A terrestrial tuberous herb 4–9 in. high: fls. white and red. W. China. B.M. 7935.

George V. Nash.†

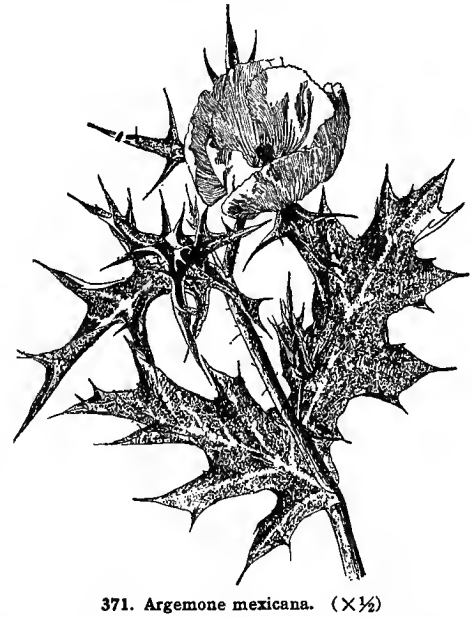
ARÈTIA: *Douglasia.*

ARGEMÒNE (Greek name for an eye disease for which a plant was reputed a remedy). *Papaveràceæ.* Argemony. Prickly garden annuals, grown for the showy yellow, white or purplish poppy-like flowers.

Coarse herbs with yellow juice and sometimes with spotted lvs.: fls. large, short-lived; sepals 2 or 3; petals 4–6; stigmas 6 or less, radiate, sessile or nearly so: pod oblong or ellipsoid, prickly or bristly, opening at top by 3–6 valves.—About 10 species of N. and S. Amer., cult. as annuals, although sometimes biennial or even perennial. Argemonies are easy to manage from seeds sown where the plants are to stand, or transplanted from pots. They need a light soil and full sunny exposure. Monogr. by Fedde, Engler's Pflanzenreich, hft. 40 (1909).

A. *Fls. yellow or yellowish.*

mexicàna, Linn. (*A. speciòsa,* Hort.). Prickly Poppy. Fig. 371. A moderately prickly-stemmed herb, 1–2 ft. high, sprawling, glaucous: lvs. coarsely sinuate-pinnatifid: fls. sessile or nearly so, the petals obovate and an inch or less long, orange or lemon-colored, to



371. Argemone mexicana. (×½)

2½ in. across when expanded. Trop. Amer., but naturalized in eastern and southern states and in many parts of the world. B.M. 243.—Not much used in this country for medicinal purposes. The plant is said to possess emetic, cathartic, anodyne and narcotic properties; the oil from the seeds acts as a mild cathartic. Var. **ochroleùca,** Lindl. Petals yellowish white, and style longer. Texas. B.R. 1343.

AA. *Fls. white (rarely purple).*

grandiflòra, Sweet. Fig. 372. Glabrous and glaucous, 1–3 ft. high, almost destitute of prickles, stout: lvs. sinuate-pinnatifid, the lobes only weakly spinescent, white-veined: bracts scattered along the fl. branches:

372. Argemone grandiflora. (×⅙)

fls. 3–6 near together, 4 in. across: caps.-valves scarcely crested. S. W. Mex. B.R. 1264. L.B.C. 16:1546. B.M. 3073.—Very showy.

platycèras, Link & Otto. Robust, 1½–4 ft., very spiny, the lvs. glaucous: lvs. sinuate-pinnatifid, spiny: fl.-bracts aggregated below the fls.; petals truncate, large, white (rarely purple), the fls. 2 in. or more across: caps.-valves crested or spiny. Var. **híspida,** Prain (*A. híspida,* Gray). Petals rounded; sepals and caps. densely prickly: plant hispid. Var. **híspido-rôsea,** Fedde. Petals rounded, rose or rosy white; sepals narrow, sparsely prickly. Var. **Hunnemánii,** Fedde. Petals rounded, white: plant stout.—The species is very variable and widely distributed in N. and S. Amer. Likely to appear in cult. in several forms; all of them have thick and densely prickly caps.-valves.

álba, Lestib. (*A. mexicàna* var. *álbiflora,* DC.). Slender, 1–3 ft., somewhat glaucous: lvs. glabrous, pinnate-lobed and sinuate, the lobes oblong-acute, spiny toothed: fls. solitary or 2–3 together, on naked peduncles, 3 in. across, white; petals oblong, narrowed at base, truncate at top. Southern states and south. B.M. 2342 (as *A. albiflora*).—Sparingly run wild. Caps.-valves thin, reticulate spiny. L. H. B.

ARGYRÈIA (*silvery,* referring to the under side of the lvs.). *Convolvulàceæ.* Silver Weed. Asiatic tender climbers allied to Ipomœa, sometimes grown in the open.

Lvs. usually large, silvery, tomentose or villous beneath: cymes usually few-fld.; corolla campanulate; sepals 5.—They require too much room before flowering to be popular in Amer. *A. cuneata* is one of the dwarfest and most floriferous kinds. Prop. by cuttings or seeds, the former over bottom heat. About 25 species.

tiliæfòlia, Wight (*Rìvea tiliæfòlia,* Hort.). Fls. white, violet or rose-purple, widely funnelform: lvs. ovate-cordate, 2–3 in. diam., shortly acuminate or obtuse. Prop. is from seeds. E. Indies.—Intro. 1890 by Peter Henderson & Co.

cuneàta, Ker-Gawl. Two to 5 ft.: st. downy: fls. large, bright but deep purple, on hairy peduncles which are shorter than the lvs.: lvs. obovate-cuneate, emarginate, glabrate. E. Indies. B.R.: 661.

A. Pierreàna, Hort.(?). Corolla funnel-shaped, white tinted with rose. Tonquin. R. H. 1906:560. See p. 3566. N. Taylor.†

ÀRIA: *Sorbus.*

ARIOCÁRPUS (*Aria-like fruit*). *Cactàceæ.* Top-shaped succulent desert plants, mostly buried in the ground, the broad aërial part covered with angular tubercles bearing no spines: fls. from the center of the plant, large, white or pink: fr. small, naked; seeds black, roughened.—A genus of 6 or 7 species confined to Cent. Mex., except a single species in S. W. Texas. A very distinct genus, easily distinguished from Mamillaria by its tubercles.

A. *Upper surface of tubercle with a broad and deep wool-bearing longitudinal groove, which widens below.*

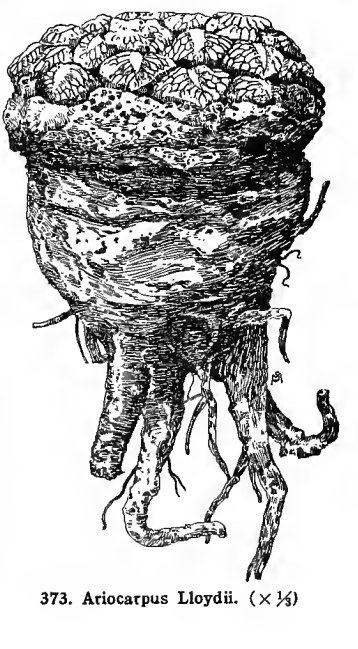
fissuràtus, Schum. (*Anhalònium Engelmannii,* Lem.). Living Rock. The flat tubercle-covered top 2–5 in. across, tapering below into a thick root; tubercles imbricated and appressed, triangular in outline, ½–1 in. long and about as wide at base, the upper surface fissured in bands, the outer ones forming an elevated margin: fls central, about 1 in. long and broad, shading from whitish to rose. On limestone hills in the "Great Bend" region of the Rio Grande in Texas, and extending into Mex. I.H. 16, p. 73, and fig. Contr. Nat. Herb. 13, pl. 62.

Lloydii, Rose. Fig. 373. Plant body with rounded top, 4 in. or more in diam.: tubercles imbricated, ⅛in. broad at base, the upper portion rounded, obtuse, broader than thick, the whole surface fissured, but not in definite bands: fls. purple, about 1½in. long; petals broad, apiculate. This species differs from *A. fissuratus* in shape and surface of tubercles, in its round top, and more southern range. Cent. Mex. Contr. Nat. Herb.13, pl. 63.

Kotschubeyànus, Schum. (*A. sulcàtus,* Schum.). Plants nearly concealed by the ground, often less than 1 in. broad at top, with a deep thick root: fl.-tube nearly ⅝in. long; petals ⅝in. long, rose-pink. Cent. Mex.—Much smaller than the last two. Only recently re-intro. into cult. A very distinct species. *A. McDòwellii,* Haage & Schmidt, is the same or a near species.

AA. *Upper surface of tubercle not grooved.*

retùsus, Scheidw. (*Anhalònium prismáticum,* Lem.). The flat top 3–8 in. across: tubercles imbricate, but squarrose-spreading, sharply triangular-pyramidal and very acute, with a sharp, cartilaginous tip, which usually disappears with age and leaves the older tubercles blunt or retuse, ¾–1 in. long and about as wide at base, the upper surface almost plane and smooth, except that it is more or less pulverulent, and often bears a small tomentose tuft just behind the claw-like tip: fls. rose-color. Mts. of Mex. —*A. trigònus,* Schum. and *A. furfuràceus,* Thompson, are similar species sometimes in cult. J. N. Rose.



373. Ariocarpus Lloydii. (×⅓)

ARISÆMA (Greek-made name, of no particular significance). *Aràceæ.* Indian Turnip. Dragon Arum. Odd hooded aroids, sometimes grown in hardy borders and some species as pot-plants.

About 60 widely distributed herbs, with

tuberous roots, and a spathe rolled in or convolute about the spadix below, and often arched over it: fls. unisexual, the pistillate on the lower part of the spadix, and each consisting of a 1-loculed ovary, and generally ripening into a showy berry. Some species are native, and several of them are hardy in the open; others are cult. under cover, as recommended for *Arum* (which see). Monogr. by Engler in De Candolle's Monographiæ Phanerogamarum, Vol. II.

A. *Lfts. 7–11.*

Dracóntium, Schott. DRAGON-ROOT. Sending up a solitary lf. 1–2 ft. high, pedately divided into oblong-lanceolate pointed lfts.: spadix long-pointed and projecting beyond the greenish spathe: scape much shorter than the lf. Low grounds in E. Amer.—Occasionally grown in borders and rockwork.

374. Jack-in-the-Pulpit, Arisæma triphyllum. (×¼)

AA. *Lfts. 3.*

triphýllum, Torr. JACK-IN-THE-PULPIT. INDIAN TURNIP. Fig. 374. Usually dicœcious: lvs. usually 2, with ovate or elliptic-ovate lfts.: spadix club-shaped and covered by the arching purplish spathe. Common in woods. V. 14:179.—Tuber or corm flattish and large, very acrid, often employed as a domestic remedy. Berries red and showy, ripening in early summer. Planted in a moist, shady place, the lvs. remain until fall; but in exposed places they die down early in summer. This and the last are very interesting native plants of easy cult., prop. by tubers and by seeds.

fimbriàtum, Mast. FRINGED CALLA. Lf. solitary, the petiole a ft. or less high, sheathed below; lfts. broad-ovate and acuminate, short-stalked: scape as long as the petiole, bearing a large, purple-limbed, white-streaked, long-pointed spathe: spadix ending in a long and gracefully drooping, feather-like appendage. E. Indies. G.C. II. 22:689; III. 15:763. B.M. 7150. Mn. 8, p. 59. G. 25:626.—A handsome and striking pot-plant, blooming in summer. Grows in rich soil. Dry off the tuber when the lvs. turn yellow after flowering, and keep dry in sand or earth until spring.

Other species are: *A. anómalum,* Hemsl. Lfts. 3, broad-ovate, acuminate: spathe small, purplish and streaked, arching over the short spadix: suggests A. triphyllum. Malaya. B.M. 7211. —*A. concínnum,* Schott. Lf. solitary, with 10 or more lfts.: spathe colored, tailed. India. B.M. 5914.—*A. curvàtum,* Hook.=A. tortuosum.—*A. Fargèsii,* Bouchet. Spathe striped longitudinally with broad purple-brown bands alternating with bands of silvery white. W. China.—*A. flàvum,* Schott. Lvs. pedate: spathe green to yellow. Himalaya. B.M. 7700.—*A. galeàtum,* N. E. Br. Lf. solitary, with 3 lfts.: spathe purple inside. India. B.M. 6457.—*A. Griffithii,* Schott. Lvs. 2; lfts. 3, nearly orbicular: spathe very large with a spreading and wrinkled limb several inches broad, and rich purple with green veins. India. B.M. 6491.—One of the handsomest of all arisæmas.—*A. japónicum,* Blume. Lvs. pedate: spathe green, white striped. B.M. 7910.—*A. nepenthoides,* Mort. Lf. pedate, of 5 narrow lfts.: spathe auricled. India. B.M. 6446.—*A. ringens,* Schott. Lfts. 3, ovate-acuminate: spathe purple, arched. Japan. Perhaps hardy in the open. Gn. 37, p. 577. G. 17:182.—*A. Sieböldii,* De Vriese.=A. ringens.—*A. speciòsum,* Mort. Lfts. 3: spathe large and very dark purple; spadix with a very long, string-like tip. India. Gn. 37:576. B.M. 5964. G.C. II. 12:585.—*A. tortuòsum,* Schott. Lvs. usually 2, with several or many lfts.: spathe purple outside; spadix long-tailed but erectish, greenish. India. B.M. 5931 (as A. curvatum).—*A. útile,* Hook. Lvs. 2, with 3 crenate lfts.: spathe reddish, green-ribbed; spadix purple: tubers eaten by natives in India. B.M. 6474.—*A. viridiflòrum,* Franch., has recently been offered in Eu., from China. It has pedate lvs., and a striped spathe.—*A. Wràyi,* Hemsl. Lf. solitary, pedate, the lfts. lanceolate: spathe green or whitish; spadix slender, recurved. India. B.M. 7105.

L. H. B.

ARISÀRUM (old Greek name). *Aràceæ.* Three or four variable species of arum-like plants of the Mediterranean region. Differs from Arisæma, its nearest ally, in having the margins of the spathe connate rather than convolute, and in other technical characters. For culture, see *Arum.*

vulgàre, Targ. (*Arum Arisàrum,* Linn.). A foot high: lvs. cordate or somewhat hastate, long-stalked: spathe purple, incurved at the top.—Has many forms and names. Can be grown in the open with protection.

A. proboscídeum, Savi. Lvs. hastate; scape less than half the petiole: spathe 1–1¼ in. long, pale gray, with a long olive tail 5–6 in., the mouth of spathe small, olive-purple. Italy. B.M. 6634. G.W. 5, p. 512.

GEORGE V. NASH.†

ARISTÈA (name refers to the stiff leaf-points). *Iridàceæ.* Mostly blue-flowered spring- or summer-blooming greenhouse herbs or sub-shrubs, and grown in the open far south.

Leaves distichous in basal rosettes, those on the st. alternate: fls. clustered in spikes, not lasting; the perianth with a short tube and oblong, spreading, nearly equal segms. that twist up spirally after flowering; stamens short-stalked, borne on the throat of perianth-tube: fr. an oblong or cylindrical 3-valved caps.—About 30 species in Afr. Of easy cult. Prop. by seeds and division. Not showy.

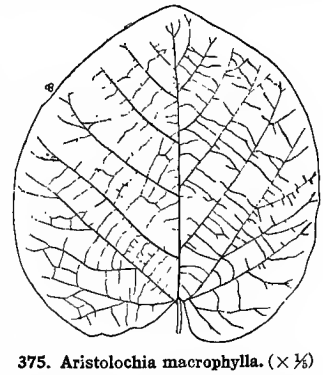
Écklonii, Baker. Herb, 1½ ft.: lvs. linear but not rigid, 18 in. or less long: fls. in many clusters that form a loose panicle with a flattened rachis; limb of blue perianth ½in. long: caps. cylindrical, less than 1 in. long. Cape Colony.—Reported in Calif., where it is said to make dense dark green clumps, with Sisyrinchium-like fls. in spring.

fruticòsa, Pers. (*Nivènia fruticòsa,* Baker). Dwarf shrub: st.-lvs. linear, 2 in. or less long: fls. in a single cluster; perianth blue, the tube ½in. long. Cape Colony.

L. H. B.

ARISTOLÒCHIA (named for supposed medicinal virtues). *Aristolochiàceæ.* BIRTHWORT. Perennial herbs or shrubs, many climbing, remarkable for the very odd-shaped flowers, some species grown in the open, but most of them cultivated as odd glass-house subjects.

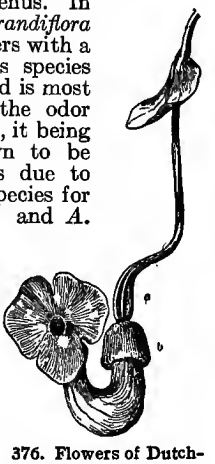
The corolla is wanting, but the calyx is corolla-like, tubular, mostly variously bent, and commonly tumid above the ovary and contracted at the mouth, superior; stamens commonly 6, short and adnate to the style, which is fleshy and lobed: fr. a naked 6-valved caps.; seeds flat.—About 180 species of warm and temperate regions throughout the earth; mostly woody twiners. Many species are evergreen. The tender species are cult. for the strikingly irregular and grotesque fls. The fls. are usually fetid in odor, often very disagreeable. Many species are grown in botanic gardens and in the collections of fanciers, but those usually cult. or planted are to be found in the treatment which follows.



375. Aristolochia macrophylla. (×⅛)

These plants are mostly climbing vines,. *A. macro-*

phylla being perhaps the best known vine for shade purposes. It is vigorous and of rapid growth, and has never been known to be attacked by fungoid or insect enemies. For covering outbuildings quickly it has no equal, owing to the heavy growth of foliage and its adaptability to any situation. The flowers are peculiar in shape, giving rise to the popular name, Dutchman's pipe. These are inconspicuous, however, compared with the tropical species of this genus. In contrast with the foregoing, *A. grandiflora* var. *Sturtevantii* has gigantic flowers with a tail sometimes 3 feet long. This species must be cultivated under glass and is most suitable for large structures as the odor when in bloom beggars description, it being such that flies have been known to be deceived, thinking its origin was due to putridity. There are other fine species for indoor culture as *A. brasiliensis* and *A. Goldieana*. These are best propagated from cuttings taken from well-matured wood in early spring or at pruning time. A rich soil is desirable and preference is given to planting the roots in a border or bed that they may be trained up rafters or pillars of warmhouses. Pot culture does not give good results. Another very pretty species is *A. elegans*. This is not odorous, can easily be procured from seeds, which are freely produced under cultivation. It will bloom the first year under glass, and may be cut back to give light to other plants in winter. The outdoor *A. macrophylla* (often known as *A. Sipho*) produces good seed; this seems to be the only way to increase it as hardwood cuttings do not root readily. (E. O. Orpet.)



376. Flowers of Dutchman's Pipe, Aristolochia macrophylla, showing the ovary at *a*, and the swelling of the calyx-tube at *b*. (×⅔)

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A. *Plant not climbing, herbaceous.*

1. **Serpentària,** Linn. VIRGINIA SNAKEROOT. Height 2 ft. or less, pubescent, with short rootstocks and aromatic roots: lvs. ovate or oblong, cordate or halberd-form, acuminate: fls. near the root, solitary, S-shaped, much enlarged above the ovary, greenish. E. U. S.—Occasionally cult. Roots used in medicine. Reputed remedy for snake-bites. Var. **hastàta,** Duch. Lvs. narrow, sagittate or hastate. Southeastern states.

2. **Clematìtis,** Linn. Two ft. or less tall, glabrous: lvs. reniform-pointed, ciliate on the margins: fls. axillary and clustered, straight, greenish. Eu.—Rarely cult., and occasionally escaped.

AA. *Plant twining, mostly woody.*

B. *Cult. in the open.*

3. **macrophýlla,** Lam. (*A. Sipho*, L'Her.). DUTCHMAN'S PIPE. PIPE VINE. Figs. 375, 376, 377. Very tall, twining, glabrous: lvs. very large, broadly reniform or rounded, becoming glabrous: fls. solitary or 2 or 3 together in the axils, U-shaped, enlarged above the ovary, with a 3-lobed, spreading flat limb, purplish. Eastern states. B.M. 534. Gng. 1:53. G.F. 5:509 (habit).—An excellent vine for porches, the great lvs. affording a dense shade.

4. **tomentòsa,** Sims. Much like the last, but very tomentose: lvs. less rounded: fls. yellow, with reflexed lobes, the closed orifice purple. N. C. to Ill. and S. B.M. 1369.

5. **californica,** Torr. Silky pubescent, 6–10 ft.: lvs. ovate-cordate, 2–4 in. long, obtuse or acutish, short-petioled: fls. U-shaped, little contracted at the throat, the limb 2-lobed, with the upper lip of 2 broad, obtuse lobes and a thickening on the inner side. Calif.

6. **moupinénsis,** Franch. Branches slender, densely silky, becoming smoothish: lvs. cordate, 5 in. or less long, hairy above, grayish pubescent beneath, the petiole about 2½ in. long: fls. solitary on axillary peduncles, the tube 1½ in. long, abruptly curved so that the blossom appears U-shaped as it hangs, pale green outside and yellowish inside, the limb obliquely 3-lobed, 1¼ in. across, yellowish and purple-marked. From the Moupine region of W. China. B.M. 8325.—A rapid grower, reaching 15 ft. in one season. A good pillar and post plant, hardy in England. Allied to *A. Kaempferi* (see supplementary list).

7. **triangulàris,** Cham. Glabrous: lvs. triangular-acute, 3-nerved, pellucid-punctate, the petioles prehensile, the blade 4 in. long by 3 in. broad: fls. solitary, ovoid-inflated at base and then making a sharp angle, the tube funnelform and the limb small and truncate and not large, purple-spotted. Brazil.—A climber reported in S. Calif.

8. **argentìna,** Griseb. Herbaceous, glabrous; st. angular-sulcate: lvs. cordate-deltoid, obtuse, pedately 7-nerved: fls. solitary on axillary peduncles, glabrous without and somewhat puberulent within, the tube ovoid at base, bent, the parts of limb broadly ovate and obtuse. S. Amer. Reported in S. Calif.

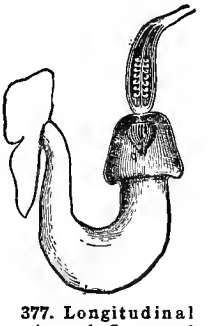
BB. *Cult. in greenhouse or warmhouse.*

C. *Fl.-limb of 2 narrow divergent lobes.*

9. **ridícula,** N. E. Br. Very slender, stiff-hairy throughout: lvs. round-reniform, cordate: fls. axillary and solitary, 2 in. long aside from the limb, with a long sac at the base of the tube, pale yellow with dull purple veining; limb of 2 spreading, deflexed, narrow lobes, glandular, reminding one of donkeys' ears. Brazil. B.M. 6934. G.C. II. 26:361.

CC. *Fl.-limb of 3 narrow lobes.*

10. **tricaudàta,** Lem. Lvs. 5–8 in. long, oblong-acuminate, rugose, ciliate: fls. solitary; tube short and somewhat inflated at the rounded base, suddenly bent; limb wide and concave, maroon-red outside and very dark purple-brown inside, produced into tails 4 in. long. Mex. I.H. 14:522. R.B. 20:37. B.M. 6067.—A fine species of shrubby habit, producing quantities of fls. all over the older parts of the growths, down to the base of the old st. A striking plant when well grown under sunny conditions in a temp. of 50–55° F.



377. Longitudinal section of flower of Dutchman's Pipe, showing the ovary, and the short column of stamens at *q*. (×1)

CCC. *Fl.-limb 2-lipped, the lips unlike and one of them usually ample and flowing: fls. large.*

D. *Blossoms with one or more long hanging tails.*

11. **grandiflòra,** Swartz (*A. gigas*, Lindl.). PELICAN-FLOWER. SWAN-FLOWER. GOOSE-FLOWER. DUCK-FLOWER. Figs. 378, 379. Downy climbing shrub: lvs. cordate-acuminate; peduncles striate, exceeding the petiole, 1-fld.: the fl.-bud is "bent like a siphon in the tube, so as to resemble the body and neck of a bird, while the limb, in that state, resembles the head and beak thrown back upon the body, as a pelican when that bird is at rest, whence

the name" (Hook. in B.M., vol. 74): the great expanded cordate-ovate limb several inches across, wavy-margined, purple-blotched and veined, terminating in a long and slender ciliated tail: strong-scented. Var. **Stûrtevantii**, W. Wats., is the form chiefly known in cult., being very large-fld., often 20 in. diam., and with a tail 3 ft. or more long. W. Indies, Cent. and S. Amer. B.M. 4368–9. B.R. 28:60. F.S. 4:351–2. G.F. 3:597–599 (adapted in Fig. 379). A.F. 10:157. G.C. III. 19:73. Gng. 3:23. Gn. 50:378. Var. **Hoôkeri**, Duch. (*A. gigantèa*, Hook.), is glabrous, inodorous, with a short-tailed fl. B.M. 4221.

378. Aristolochia grandiflora, var.

DD. *Blossoms not tailed, although perhaps bearing long more or less erect point-appendages.*

12. **Goldieàna**, Hook. Whole plant dying down to a large fleshy rootstock: glabrous: lvs. ovate-cordate or triangular-cordate, acuminate, the base deeply cut: fls. very large, greenish outside but brown-veined and blotched inside, the lower part of the tube straightish and 8 in. long, the upper part sharply bent over and a foot long, with a funnel-shaped, spreading limb a foot or more across, and indistinctly 3-lobed, each lobe terminated by slender appendages; stamens 24. W. Afr. B.M. 5672. G.C. III. 7:521; 21:337. G.M. 33:286.

13. **brasiliénsis**, Mart. & Zucc. Glabrous: lvs. cordate-reniform, obtuse, with deep sinus at base: peduncle 8–10 in. long, 1-fld.: fl. very large, dingy yellow, with marks and reticulations of purple, the limb strongly 2-lipped; tube strongly bent, purple inside; upper lip 4 in. long, violet within, hairy; lower lip not longer than the upper, 5–7 in. wide. Var. **macrophýlla**, Duch. (*A. ornithocéphala*, Hook.). Lvs. large: upper lip 5 in. long, lanceolate-acuminate, projecting from the inflated headlike tube like the long beak of a bird; lower lip on a stalk 2 in. long, then expanding into a flattened, wavy, beautifully marked limb 4 in. long and 4–6 in. across. Brazil. B.M. 4120. Gn. 45, p. 289.—A most odd and interesting species, not infrequent in fine establishments.

14. **élegans**, Mast. CALICO FLOWER. Slender, glabrous, the fls. borne on the pendulous young wood: lvs. long-stalked, reniform-cordate, 2–3 in. across, with wide sinus and rounded basal lobes, the tip obtuse: fls. solitary, long-stalked, the tube yellow-green, 1½ in. long, the limb cordate-circular, 3 in. across, purple and white blotched, white on the exterior, the eye yellow: not strong-smelling. Brazil. G.C. II. 24:301; III. 22: 123. B.M. 6909.—A small-fld. and graceful, free-blooming species. A most desirable decorative climber for a warm greenhouse of 55° F. but does not thrive so well in a stove. It is entirely devoid of the unpleasant odor which is characteristic of the fls. of this genus. In Fla. it self-sows freely; and the hanging basket-like frs. are very attractive.

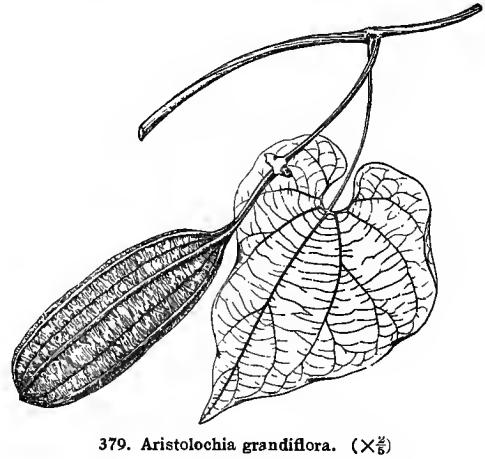
15. **cymbífera**, Mart. & Zucc. (*A. labiòsa*, Sims). Glabrous: st. striate: lvs. reniform, obtuse and deeply cut at the base, pedately 7–9-nerved, long-stalked: fls. long-stalked, 8–10 in. long, strongly 2-lipped; the upper lip short and lanceolate, acute or acuminate; the lower lip (which, by position of fl. may seem to be the upper) very large, dilated at base, and produced into a long, boat-shaped (whence the name, from *cymba*, a boat) usually 2-lobed projection; fl. creamy white, marked and blotched with maroon. Brazil. B.M. 2545. P.M. 6:53 (as *A. hyperborea*, Paxt.).

A. altíssima, Desf. Fls. 2 in. or less long, brownish. Sicily and Algeria. B.M. 6586.—Would probably be hardy with protection in the middle states.—*A. angulícida*, Jacq. Lvs. long-cordate: fls. small, 1–2 in. long, with a long-pointed limb. Colombia. B.M. 4361. F.S. 4:344.—*A. barbàta*, Jacq. Lvs. oblong and cordate: fls. 2½ in., purple. Venezuela. B.M. 5869.—*A. caudàta*, Booth=A. macroura.—*A. ciliàta*, Hook., and *A. ciliòsa*, Benth.=A. fimbriata.—*A. clypeàta*, Lindl. & André. Lvs. triangular-ovate, pointed: fls. with a large, oval, purple-spotted, tailless limb. S. Amer. I.H. 17:40. B.M. 7512.—*A. Duchártrei*, André =A. Ruiziana.—*A. fimbriàta*, Cham. A free-flowering greenhouse species: lvs. small, cordate-orbicular: fls. small, the little limb glandular-ciliate. Brazil. B.M. 3756 (as A. ciliata).—*A. hìans*, Willd. Lvs. round-cordate: fls. bronze-green, with lobed limb and a hairy beak. Venezuela. B.M. 7073. Allied to A. brasiliensis.—*A. Kaémpferi*. Willd. Tall-climbing: lvs. ovate-cordate or hastate, variable: fls. solitary, tomentose, with narrow rim, yellow outside, purpls inside. Japan. Probably hardy in the N.—*A. longicaudàta*, Mast. Lvs. ovate and cordate: fls. cream-colored with purple markings, with a large sac-like tube, hairy at the throat, with no expanded limb but a very long tail. S. Amer. G.C. III. 8:493.—*A. longifòlia*, Champ. Branches climbing, from a woody rootstock: lvs. thick, linear-lanceolate: fls. U-shaped, with a 2-lobed purple limb 2½ in. across. Hong Kong. B.M. 6884.—*A. macroùra*, Gomez. Lvs. reniform, lobed: fl. dark maroon, 6-spurred, the lip with a twisted cusp. Brazil. B.M. 3769 (as A. caudata).—*A. macroùra* ×*brasiliénsis*, a garden hybrid.—*A. odoratíssima*, Linn. Lvs. cordate-ovate: fl. solitary, purple, sweet. Jamaica.—*A. póntica*, Linn. Erect or ascending from a globose rootstock: lvs. large, broadly ovate: fls. very large, curved, greenish purple, ill-smelling. Asia Minor.—*A. ríngens*, Vahl. Lvs. round-reniform: fl. 7–10 in. long, green marked with dark purple, hairy inside, with 2 long lips, one of which has a much-expanded limb. Brazil. B.M. 5700.—*A. Ruiziàna*, Duch. Lvs. reniform-cordate: fls. with tube 1 in. or less long, the cordate-ovate limb 3 in. across, and brown-spotted. Brazil. B.M. 5880 and G.C. 1868:516 (as A. Duchartrei).—*A. saccàta*, Wall. Lvs. long-ovate: fls. small, U-shaped, with a very narrow rim (suggesting the Dutchman's pipe), red. India. B.M. 3640.—*A. Sálpinx*, Mast. Lvs. ovate-lanceolate: fls. small, with a trumpet-shaped, somewhat 2-lipped mouth, purplish. Paraguay. G.C. II. 26:457.—*A. unguliífòlia*, Mast. Lvs. 3-lobed: fls. small, brownish and reddish, with a ciliate, tongue-like lip. Borneo. G.C. II. 14:117. B.M. 7424.—*A. Wéstlandii*, Hemsl. Lvs. oblong-lanceolate: fl. pendulous, with a spreading purple-marked limb 5 or 6 in. across. China. B.M. 7011. A greenhouse climber producing its fls. on the old parts of the plant near the ground.

L. H. B.

ARISTOTÈLIA (after the Greek philosopher Aristotle). *Elæocarpàceæ*. Woody plants sometimes grown in the open in warm countries.

Leaves evergreen, nearly opposite, entire or toothed: fls. polygamous; sepals 4–5, valvate; petals of the same number: berries small, edible.—A genus of 7 species of trees and shrubs from the southern hemisphere, allied to Elæocarpus. Prop. by ripened cuttings, under bell-jar or closed frame.



379. Aristolochia grandiflora. (×⅖)

racemòsa, Hook. f. NEW ZEALAND WINEBERRY. Small tree, 20 ft.: lvs. glossy, ovate or cordate-ovate, thin and membranous: fls. white in many-fld. panicled racemes. New Zeal.—Cult. somewhat in S. Calif.

Mácqui, L'Her. Shrub, to 7 ft.: lvs. almost opposite, dentate, smooth, shining, oblong and acute at the apex: fls. inconspicuous, greenish, axillary. Chile.—Grown for its foliage. A variegated form, less hardy than the type, is known. Occasionally found in botanical and other collections, particularly in Calif. N. TAYLOR.†

ARMENÌACA: *Prunus.*

ARMÈRIA (an old Latin name). *Plumbaginàceæ.* SEA PINK. THRIFT. Small perennial herbs, with rosettes of narrow evergreen leaves on the ground, planted along borders and walks, used for continuous low edgings and in rock-gardens; sometimes grown as pot-plants.

Scape naked, simple, 2–12 in. high, on which is borne a compact head of pink, lilac or white fls., the head being subtended by small bracts, forming a kind of involucre; fls. with plaited funnel-shaped dry calyx, the lobes pointed; 5 petals nearly or quite distinct and tapering at the base; 5 stamens opposite the corolla parts; styles 5, hairy below the middle: fr. a utricle inclosed in the calyx.—About 50 species in Eu., W. Asia, N. Afr. and 1 in N. Amer., much confused.

Armerias are of easiest culture, being hardy and free growers. Propagation is by division of the stools; also by seeds.

A. *Calyx-tube usually pilose all over.*

vulgàris, Willd. (*A. marítima,* Willd.). COMMON THRIFT. Fig. 380. Lvs. linear, 1-nerved, somewhat obtuse, glabrous or slightly ciliate: scape low, somewhat villose; calyx-tube about the length of the pedicel and decurrent on it, the limb nearly equal to the tube, with very short ovate, blunt or aristate lobes. Eu. and Amer., along the seacoast. Var. **álba,** Hort. White. Var. **rùbra,** Hort. Fls. dark rose-red. Var. **purpùrea,** Hort. Purple-red. Var. **Laucheàna,** Voss. Light rose-color. Var. **grandiflòra,** Hort. Large-fld., light rose-red. Var. **splèndens,** Hort. Bright pink. *A. argéntea,* Hort., is perhaps another form, with small white fls.; also a white-lvd. form.

sibírica, Turcz. Lvs. linear, 1-nerved, obtuse, glabrous: scape rather taller, thicker; calyx-tube longer than pedicel, the limb about length of tube, with triangular, short-mucronate lobes; involucre brown; fls. white. Siberia.

júncea, Girard (*A. setàcea,* Delile). Outer lvs. of rosette narrow-linear and subdentate, the inner ones longer and filiform: head small, with pale involucre, the pedicel much shorter than the calyx-tube; calyx-limb short, the lobes ovate-obtuse and aristate; fls. pink. Eu.

AA. *Calyx-tube glabrous, or pilose only on the ridges.*

B. *Lvs. elliptic-lanceolate or broader.*

latifòlia, Willd. (*A. cephalòtes,* Link & Hoffm., not Hook.). Glabrous and glaucous: lvs. broad-oblong, 5–7-nerved, the margin remotely denticulate: head large, the involucre dry; calyx-limb long, with very small or no lobes and long teeth; fls. bright pink. S. Eu. B.M. 7313. P.M. 11:79 (as *Statice Pseudo-armeria*).—*A. formòsa,* Hort., probably belongs here.

mauritánica, Wallr. (*A. cephalòtes,* Hook., not Link & Hoffm.). Lvs. broad-spatulate or elliptic-lanceolate, 3–5-nerved, glaucous green, the margin scarious-white: heads large (2–3 in. across), the involucre brownish, the calyx short-toothed and aristate; fls. pink. Eu., Algeria.

BB. *Lvs. linear-lanceolate or narrower.*

alpìna, Willd. Glabrous: lvs. linear-lanceolate; equaling the scape, 1-nerved or obscurely 3-nerved: head large, the involucre pale brown; pedicels shorter than calyx-tube, the tube equaling the oblong long-aristate lobes; fls. deep rose. Mts., Eu.

purpùrea, Koch. Lvs. linear, long, 1-nerved, blunt: outer involucre-scales mostly blunt, the inner very blunt and weak: pedicels as long as calyx-tube, limb equaling the tube, and the lobes ovate-aristate; purple. Cent. Eu.

plantagínea, Willd. Glabrous: lvs. linear-lanceolate, 3–7-nerved, acute or acuminate: scape tall; head dense and globular, the involucre white; pedicels as long as calyx-tube, the lobes ovate and long-aristate and as long as tube; pink. Cent. and S. Eu. Var. **leucántha,** Boiss. (*A. dianthoìdes,* Hornem. & Spreng.), has white fls.

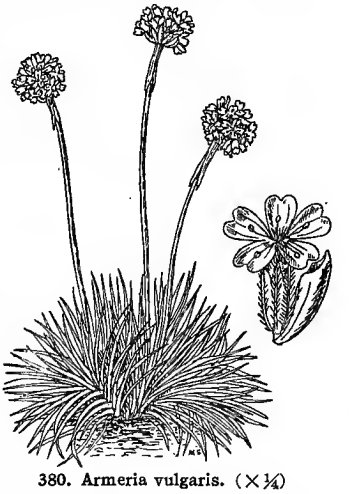
argyrocéphala, Wallr. (*A. undulàta,* Boiss.). Glabrous: outer lvs. in rosette, short and lanceolate or linear-lanceolate and 3-nerved and often sinuate, the inner ones linear or setaceous and 1–3-nerved: head large, the involucre white; pedicel nearly as long as calyx-tube, the calyx-limb with long-triangular aristate lobes; fls. white, showy. Greece. L. H. B.†

ARMERIÁSTRUM: *Acantholimon.*

ARNATTO: *Bixa.*

ARNÈBIA (Arabic name). *Boraginàceæ.* Annual or perennial hispid herbs, grown as flower-garden or border subjects.

Erect or diffuse: root sometimes yielding red tint: lvs. alternate: fls. yellow or violet, in racemes or cymes, the color changing with the age of the blossom; corolla slender-tubed, with 5 obtuse lobes, the throat devoid of scales; stamens included; style usually bifid: fr. normally of 4 erect nutlets.—A dozen species in Asia and N. Afr. of easy cult. in gardens.



380. Armeria vulgaris. (×¼)

echioìdes, DC. (*Macrotòmia echioìdes,* Boiss.). PROPHET-FLOWER. Hardy perennial, 3–12 in. high, short-hairy, with spreading, obovate-oblong lvs.: fls. in a scorpioid raceme or spike, yellow, with purple spots, fading to pure yellow. Caucasus, Armenia, etc. B. M. 4409. G.C. II. 11:689.—Blooms in spring. In full sun or in rather dry ground, it is difficult to keep this charming plant in a healthy condition; partial shade is essential to its welfare. One can grow luxuriant specimens on the northern slope of a rockery or close to a building on the east or north side. Prop. by seeds, division, or by root-cuttings.

cornùta, Fisch. & Mey. ARABIAN PRIMROSE. Annual, 2 ft., bushy: lvs. lanceolate or linear-oblong, pointed: fls. ¾in. across, yellow and black-spotted, changing to maroon and then to yellow. Orient. G.C. III. 7:52. J.H. III. 31:29. A.F. 5:400. A.G. 11:181 (1890).—An attractive and not very common annual, easily grown in the open.

A. Griffithii, Boiss. Annual, 9–12 in.: lvs. narrow-oblong, obtuse, ciliate: fls. long-tubed, with a black spot in each sinus. India. B.M. 5266.—*A. macrothyrsa,* Stapf. Perennial, 1 to nearly 2 ft.: fls. yellow in dense thyrses. Armenia. L. H. B.†

ÁRNICA (ancient name). *Compósitæ.* Perennial herbs sometimes seen in borders or rockeries.

With clustered root-lvs. and opposite st.-lvs. and large, long-peduncled yellow heads: involucral bracts all equal,

thin, in a single, rarely double series. Native to Eu., Asia, and N. Amer., about 10 species.—Tincture of the European *A. montana* is used in medicine. Grown mostly as alpines or in rockwork; some species also grow well in the common border. Prop. by division, and rarely by seeds.

381. Arnica montana. (×⅓)

A. *Radical lvs. cordate, with slender or winged petioles.*

cordifòlia, Hook. Two ft. or less high, hairy: heads few or even solitary, with inch-long rays; involucre ⅔in. high, pubescent. Rocky Mts. and W.—To be grown as an alpine.

latifòlia, Bongard (*A. ventòrum,* Greene). Glabrous or very nearly so, the st.-lvs. not cordate or petioled, the radical lvs. nearly round: heads smaller than in preceding. Rocky Mts. and W.

AA. *Radical lvs. not cordate, often petioled.*

amplexicaùlis, Nutt. Glabrous or nearly so: lvs. ovate to lance-oblong, acute, those on the st. clasping and dentate: st. leafy to the top. Ore. and N.

foliòsa, Nutt. Pubescent: lvs. lanceolate, strongly nerved, small-toothed, the upper ones somewhat clasping: heads sometimes solitary, short-peduncled: st. leafy, strict. Rocky Mts. and W.

montàna, Linn. Mountain Tobacco. Mountain Snuff. Fig. 381. A foot high, the st. sparsely hairy: radical lvs. oblong-lanceolate, glabrous and entire: heads 3–4, large. Eu. B.M. 1749. J.H. III. 34:441. Gn. 24, p. 394. G. 29:215.—The best known species in cultivation and can be grown in the open border, but none of the arnicas is common in American gardens.

A. Clùsii=Doronicum Clusii.

L. H. B.
N. Taylor.†

ARÒNIA (modification of *Aria,* a subgenus of the allied genus Sorbus). *Rosàceæ.* Chokeberry. Ornamental shrubs grown for their attractive white flowers and for their handsome fruits, and also for the bright autumnal tints of the foliage.

Low plants: lvs. deciduous, short-petioled, finely and crenately serrate, glandular on the midrib above, convolute in bud: fls. in small corymbs, white; calyx 5-lobed, petals 5, spreading; stamens numerous; ovary 5-celled, woolly at the top, with 5 styles united at the base, the carpels connate but partly free on their ventral suture: fr. a small pome, flesh without grit-cells, top hemispherical.—Three closely related species in E. N. Amer. Closely related to Sorbus, which is easily distinguished by the sharply or doubly serrate, often pinnate lvs. folded in bud and without glands above, by the usually 2–3-celled ovary with the carpels connate on their ventral suture, otherwise often partly free, and by the conical top of the fr.: quite distinct in general appearance and habit and suggesting more an affinity with Amelanchier.

The aronias are small shrubs with simple deciduous leaves turning bright red in autumn and with white flowers in small corymbs followed by berry-like, red, purple or black fruit. Well adapted for borders of shrubberies and quite hardy North. *A. melanocarpa* is handsomest in foliage and bloom, particularly the var. *grandifolia;* its fruit ripens in August, but soon shrivels and drops, while *A. atropurpurea* and *A. arbutifolia* have showier and usually more numerous fruits; those of *A. atropurpurea* ripen in early September and shrivel at the beginning of the winter, while those of the last-named species ripen later and remain plump and bright far into the winter.

They prefer moist situations, but *A. melanocarpa* also grows well on drier and rocky soil. Propagation is by seeds sown in fall or stratified; also by suckers and layers, or by greenwood cuttings under glass.

arbutifòlia, Spach (*Sòrbus arbutifòlia,* Heynh. *Pỳrus arbutifòlia,* Linn. f. *A. arbutifòlia,* Ell. *A. pyrifòlia,* Pers. *Méspilus arbutifòlia* var. *erythrocárpa,* Michx.). Red Chokeberry. Upright shrub, 6–10 ft. high: lvs. short-petioled, oval to oblong or obovate, acute or abruptly acuminate, crenately serrate, glabrous above except some glands on the midrib, whitish or grayish green and tomentose or pubescent beneath, 1½–3 in. long: corymbs tomentose, few- to many-fld., 1–1½ in. broad; fls. white or tinged red, ⅓–½in. across: fr. subglobose or pear-shaped, bright or dull red, about ¼in. across. April, May. N. Y. to Minn., to Fla. and La. B.M. 3668. G.F. 3:417. G.W. 5, p. 245.

atropurpùrea, Brit. (*Sórbus arbutifòlia* var. *atropurpùrea,* Schneid.). Purple Chokeberry. Shrub, to 12 ft., closely allied to the last: lvs. oblong to obovate, grayish pubescent beneath, 2–3½ in. long; corymbs tomentose, many-fld.: fr. ovoid to subglobose, purplish black, about ⅓in. high. May, June. Nova Scotia to Fla.

melanocárpa, Spach (*Sórbus melanocárpa,* Heynh. *Pỳrus nìgra,* Sarg. *A. nìgra,* Koehne. *Pỳrus arbutifòlia* var. *nìgra,* Willd.). Black Chokeberry. Low shrub, rarely to 6 ft.: lvs. oval to obovate, abruptly acuminate or obtuse, pale green and glabrous or nearly so beneath: calyx and pedicels glabrous or nearly so: fr. globose, about ⅓in. across, shining black. Nova Scotia to Ont., south to Fla. and Mich. April–June. B.B. 2:237. Var. **grandifòlia,** Schneid. (*Pỳrus grandifòlia,*

382. Aronia melanocarpa var. elata. (×⅓)

Lindl.). A taller, more vigorous shrub with larger, obovate or broadly obovate lustrous lvs. and larger fls. in larger corymbs. B.R. 14:1154. Var **elàta,** Rehd. Fig. 382. Similar to the preceding, but lvs. narrower, generally oblong-obovate, acute. Var. **subpubéscens,** Schneid. Lvs. pubescent beneath when young.

A. floribúnda, Spach (Pyrus floribunda, Lindl.). Hybrid between A. arbutifolia and A. melanocarpa, similar to A. atropurpurea, but usually more glabrescent. B.R. 12:1006. G.W. 5, p. 246.—It is of garden origin and several forms of it are in cult.

Alfred Rehder.

ARPOPHÝLLUM (*cimiter* and *leaf*). *Orchidàceæ.* Epiphytic evergreen orchids, with 1-lvd. sts. arising from creeping rhizomes: lvs. coriaceous or fleshy: fls. numerous, sessile, in dense cylindric spikes; sepals and petals nearly alike, spreading; lip adnate to base of the erect column, narrowed above the somewhat saccate base; pollinia 8.—About 6 species, natives of Mex., Cent. Amer., and W. Indies.

gigantèum, Lindl. Sts. stout, up to 1 ft. tall: lvs. 12–16 in. long: spike dense, up to 1 ft. long; fls. rose-purple, the broadly obovate lip deeper. Mex. and Guatemala.

spicàtum, Llav. & Lex. Fig. 383. Sts. up to 8 in. tall: lvs. up to 1 ft. long: spike dense, 3–6 in. long; fls. less than ½in. across, numerous; sepals and petals rose-purple; lip bright purple. Mex. B.M. 6022.

GEORGE V. NASH.

ARRACÀCIA (Spanish name of the plants). *Umbellíferæ.* Also spelled *Arracacha.* Twenty to 30 species of perennial herbs closely allied to Conium, with calyx-teeth very small or wanting, petals broad, acuminate and inflexed, white to dark purple, fls. in large compound umbels: lvs. pinnately compound or decompound. *A. xanthorrhìza,* Bancr. (*A. esculénta,* DC.), produces edible tuberous roots much eaten by residents of N. S. Amer.; these tubers have branches or lobes the size of carrots, and are boiled. *A. Dugèsii,* Coulter & Rose, Cent. Amer., is reported as a botanic-garden plant. It is tall and coarse, aromatic: lvs. much decompound, segm. linear.

ARRHENATHÈRUM (Greek *arren,* masculine, and *ather,* awn, in reference to the awned staminate flower). *Gramineæ.* OAT GRASS. Tall perennials with flat blades and long narrow panicles: spikelets 2-fld., the lower staminate, its lemma bearing a geniculate twisted dorsal awn, the upper perfect, short-awned or awnless. Species 6, Medit. region. One species, tall oat-grass (*A. elàtius,* Beauv.), is cult. as a meadow grass. Dept. Agric., Div. Agrost. 20:95. There has been recently intro. into the eastern states a variety (var. *tuberòsum,* Halac. *A. bulbòsum,* Presl) that bears at the base of the culms a short chain of corms. A variegated form of this has been offered under the name *A. bulbòsum variegàtum.*

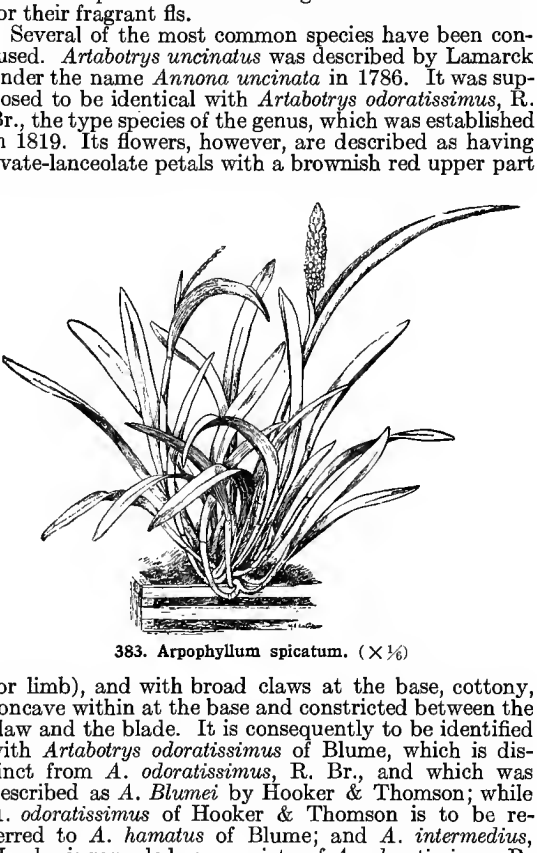
A. S. HITCHCOCK.

ARROW-ROOT. An edible starch, derived from the rhizomes of various scitaminaceous plants, as Maranta, Curcuma, Tacca, Canna. The West Indian arrow-root is mostly from *Maranta arundinacea.* The Brazilian is from *Manihot utilissima.* The East Indian is chiefly from *Curcuma angustifolia.* Potato and maize starches are also a source of arrow-root. In the United States starch is secured from Cassava (*Manihot utilissima*) and is used as a substitute for arrow-root. See Cyclo. Amer. Agric., Vol. II, p. 199, with figure of *Maranta arundinacea.*

ARTABÒTRYS (Greek, *suspended grapes,* alluding to the clustered fruit suspended by the hooked peduncle). *Annonàceæ.* CLIMBING YLANG-YLANG. TAIL-GRAPE. Woody tropical climbers or scrambling shrubs, remarkable for their curiously hooked peduncles, and prized for the fragrance of their flowers.

Leaves smooth, evergreen, alternate: petals 6 in 2 series, both series valvate or edge-to-edge, in most species flat but in certain Malayan and African species terete or club-shaped, with a broad excavated base, above which they are constricted and connivent over the essential parts, which they almost conceal, the flat or terete limb above the constriction usually spreading and ascending, sometimes slightly incurved: stamens typically annonaceous, closely packed, wedge-shaped or oblong with 2 dorsal pollen-sacs on the back of the thick filament and connective produced above them in the form of a dilated hood or cap: ovaries several, seldom numerous, each with 2 erect basal ovules side by side; styles variable, sometimes oblong or club-shaped and reflexed, sometimes erect or very small; ripe carpels separate, borne in a cluster on the hardened torus or receptacle, either sessile or stipitate, more or less plum-like or olive-like, and normally containing 2 flattened seeds with hard bony testa, rising side by side from the base, grooved around the margin and containing the wrinkled albumen characteristic of all Annonaceæ. E. Asia, the Malay Archipelago, and Trop. Afr.—About 40 species thus far described, several of them cult. in tropical countries and grown in conservatories for their fragrant fls.

Several of the most common species have been confused. *Artabotrys uncinatus* was described by Lamarck under the name *Annona uncinata* in 1786. It was supposed to be identical with *Artabotrys odoratissimus,* R. Br., the type species of the genus, which was established in 1819. Its flowers, however, are described as having ovate-lanceolate petals with a brownish red upper part



383. Arpophyllum spicatum. (×⅙)

(or limb), and with broad claws at the base, cottony, concave within at the base and constricted between the claw and the blade. It is consequently to be identified with *Artabotrys odoratissimus* of Blume, which is distinct from *A. odoratissimus,* R. Br., and which was described as *A. Blumei* by Hooker & Thomson; while *A. odoratissimus* of Hooker & Thomson is to be referred to *A. hamatus* of Blume; and *A. intermedius,* Hassk., is regarded as a variety of *A. odoratissimus,* R. Br.

A. *Shape of petals lanceolate or ovate, flat.*

B. *Petals glabrous, more than an inch long.*

odoratíssimus, R. Br. CLIMBING YLANG-YLANG. ALANG-ILANG SONGSONG. TAIL-GRAPE. ALANG-ILANG DE CHINA. A woody climber or half-scandent shrub: young branches puberulous, at length glabrous: lvs. short-petioled, oblong or oblong-lanceolate, acuminate, acute at the base, thin, coriaceous, both sides glabrous, glossy, reticulate between the lateral nerves: hooked peduncles 1- or 2-fld., extra-axillary, usually opposite a lf. or subterminal; fls. rather large, greenish to yellow, very fragrant; petals flat, glabrous, or silky-puberulous at the base, thick and coriaceous, lanceolate to oblong-lanceolate, nearly 2 in. long when full-grown, constricted near the base and connivent over the essential parts, widely spreading above the constriction, inner petals similar to the outer but slightly smaller; stamens numerous, short and thick, wedge-shaped, with the connective broadly dilated above the 2 pollen-sacs, which are adnate on the back of the fleshy filament and open extrorsely by longitudinal fissures; ovaries

glabrous, several, each with 2 erect ovules at the base; styles linear-oblong or club-shaped: berries plum-like, clustered on the hardened receptacle, oblong, narrowed at the base, nearly sessile, with a small point at the apex, smooth, yellow and fragrant when ripe. S. China, Formosa, India, Ceylon, Burma, Philippine Isls. B.R. 423.—A species widely cult. in the warm countries of the eastern hemisphere and in conservatories, for its fragrant fls. and frs. This species is tender in Cent. Fla. and should be banked with dry sand. It needs rich soil and should be well fertilized each year. Easily prop. by seeds.

BB. *Petals tomentose or pubescent, not exceeding an inch in length.*

C. *Fr. ovoid, sharp-pointed: petals ovate-lanceolate, brownish red, pubescent.*

uncinàtus, Safford (*Annòna uncinàta,* Lam.). Fig. 384. A shrub with climbing divaricate branches; young branches slightly pubescent at first, at length glabrous, more or less zigzag: lvs. lanceolate or oblong-lanceolate, acuminate, usually acute at the base, glabrous on both

384. Artabotrys uncinatus. (×½)

sides, glossy, and with short thick petioles, 5–10 in. long by 2–3 in. broad: hooked peduncles glabrous, curved downwards almost like a spiral, somewhat flattened, usually opposite a lf., often with the portion of the branch above it more or less aborted, so as to make it appear terminal; calyx 3-parted, the divisions ovate-acute; petals 6, ovate-lanceolate, brownish red on the upper part, with broad claws, woolly or pubescent ("cottoneux"), concave within and constricted between the claw and the limb, the 3 outer petals about ¾in. long, somewhat larger than the inner, and relatively broader; ovaries about 8–12, gradually tapering upward to the obtuse stigmatic apex, clothed with minute hairs, and containing 2 basal collateral erect ovules: frs. several, rounded-ovoid, abruptly pointed at the apex, nearly sessile, about the size of a walnut inclosed in its hull, at length smooth, lightly punctate, and inclosing 2 oblong seeds truncated at the base, rising side by side from the base, more or less compressed and bearing a marginal groove around the periphery of the hard bony testa.—This species was described by Lamarck from specimens collected by Sonnerat in the E. Indies and Madagascar (see figs. Dunal Anon. pls. 12, 12*a*). It is very closely related to *A. odoratissimus,* R. Br., from which it apparently differs in the broader shape, reddish brown color, and "cottony" indumentum of its petals. If, as supposed by many botanists, the two species are identical, the specific name *uncinatus* of Blume, which it more closely resembles, the latter, set apart by Hooker & Thomson as a distinct species under the name *A. Blumei,* must yield to the earlier specific name, and *A. odoratissimus,* R. Br., be retained as a species distinct from Lamarck's though supposed by its author and his followers to be identical with it. *A. uncinatus,* like its very close ally, *A. odoratissimus,* is frequently planted in the warm regions of the eastern hemisphere for the sake of its fragrant fls.

CC. *Fr. tapering at both ends: petals linear-lanceolate, tomentose.*

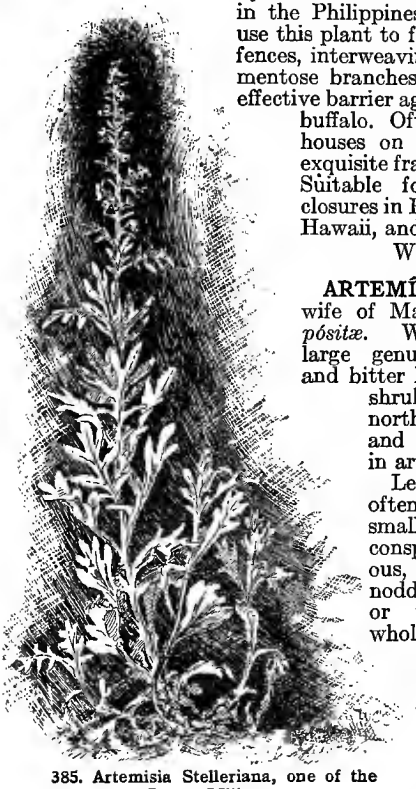
hamàtus, Blume (*A. odoratissimus,* Hook. f. & Thomson). A large scrambling shrub with elongate sarmentose glabrous branches: lvs. oblong-lanceolate, obtusely acuminate, acute at the base, 2–4 in. long by 1–1½ in. broad, coriaceous, glabrous, delicately veined on both surfaces: hooked peduncles flattened, glabrous, spirally curved, several-fld. but usually all but one of the fls. abortive; pedicel curved, clothed with short pubescence and bearing at the base a sessile ovate caducous bracteole; fls. yellowish ferrugineous; calyx minute, subtomentose, deciduous, deeply 3-parted, the divisions broadly ovate-acute, spreading and reflexed; outer and inner petals of equal length, 1 in. long, linear-lanceolate, obtusely acuminate, thickish, tomentose, excavated and constricted at the base, conniving over the essential parts and almost concealing them, the limb, above the constriction, curving somewhat inward, with a raised median line along the back and a groove within, the outer petals somewhat broader than the inner; receptacle plano-convex, clothed with minute hairs; stamens numerous, thick, club-shaped, obtuse, the connective swollen and rounded above the pollen-sacs; ovaries few, about 5–8, linear-oblong, glabrous, tapering upward into the terete style; mature hardened receptacle bearing 3–5 fruiting carpels 2–2½ in. long and 1 in. diam., tapering toward both ends, obtusely acuminate, rather smooth, marked with longitudinal lines within from the base to the apex and spotted with greenish and white, at length turning red; seeds 2, erect, side by side, oval, with a hard bony pericarp surrounded by a marginal groove, and a large ruminate albumen. Java, common at the base of high mts.—Widely diffused in India and Ceylon, and planted for the sake of its fragrant fls., often scrambling over garden walls. Closely allied to this species is *Artabotrys intermedius,* Hassk., which grows in the botanical gardens of Buitenzorg, on the island of Java. Its calyx is described as silky within, its petals as green and covered with fine tomentum, the exterior ones a little broader and longer than the inner (an inch long), and ovate-lanceolate in shape, and the ripe carpels obovoid and acutish.

AA. *Shape of petals cylindrical or club-shaped, fleshy: peduncles several-fld.*

suavèolens, Blume. BUFFALO THORN. DURIE CARABAO. SUSONG DAMULAG. A large woody climber or scrambling shrub: young branches puberulous: lvs. elliptic-oblong to oblong-lanceolate, 2–5 in. long by 1–1½ in. broad, acuminate, at the acute or obtuse base usually narrowed into a short glabrous petiole, coriaceous or subcoriaceous, glabrous or pubescent on the midrib beneath, glossy above, conspicuously veined on both sides: peduncles short, recurved or hooked, flattened and fasciated, puberulous, several-fld.; fls. very fragrant, small, yellow, borne on pedicels ½in. long or less; petals all similar, about ½in. long, fleshy, terete or club-shaped, broad and concave at the base, where they connive to form a dome-shaped covering over the essential parts; stamens many, short and thick,

wedge-shaped, with a very broad truncate or flattened connective above the two pollen-sacs; ovaries few, about 3–5, broadly ovoid, subcompressed, terminating in a small stigma and containing 2 basal ovules; fruiting carpels 2 or 3, oblong, obtuse, slightly contracted at the base, sessile; seed usually solitary. All Malayan provinces at low elevations, common; distribution from Sylhet to Burma; also occurring in the Philippines.—The natives use this plant to form hedges and fences, interweaving the long sarmentose branches, which form an effective barrier against cattle and buffalo. Often planted near houses on account of the exquisite fragrance of its fls. Suitable for forming inclosures in Fla., Porto Rico, Hawaii, and S. Calif.

W. E. Safford.



385. Artemisia Stelleriana, one of the Dusty Millers.

ARTEMÍSIA (*Artemisia*, wife of Mausolus). *Compósitæ*. Wormwood. A large genus of aromatic and bitter herbs and small shrubs, mostly in the northern hemisphere, and most abundant in arid regions.

Leaves alternate, often dissected: heads small and mostly inconspicuous, numerous, and generally nodding, with yellow or whitish florets, wholly discoid, the involucre imbricated in several rows.

In the West, many of the species, particularly *A. tridentata*, are known as sage brush. Grown for their medicinal properties or for foliage effects. The drug product of the artemisias is large. *A. Absinthium* is the chief source of absinthe; *A. Barrelieri*, Bess., of Spain, is said to be used in the preparation of Algerian absinthe; *A. Cina*, Berger, of the Orient, is the source of santonica. The garden kinds are perennials and thrive in the most ordinary conditions, even in poor and dry soil. Propagation is mostly by division.

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A. *Heads with two kinds of florets (heterogamous).*

B. *Disk-fls. with both stamens and pistils, but the ovary abortive (not producing seed); style usually entire.*

1. Dracúnculus, Linn. Tarragon. Estragon. Herb; green and glabrous, with erect, branched sts. 2 ft. high: radical lvs. 3-parted at the top; st.-lvs. linear or lanceolate, entire or small-toothed: panicle spreading, with whitish green, nearly globular fl.-heads. Eu. R.H. 1896, p. 285.—Tarragon lvs. are used for seasoning, but the plant is little grown in this country. The lvs. may be dried in the fall, or roots may be forced in a coolhouse in the winter. Prop. by division; rarely produces seed. See *Tarragon*.

2. canadénsis, Michx. Herb, 2 ft. or less high, glabrous or very nearly so: lvs. usually 2-pinnate, with filiform, plane lobes: fls. in a long, narrow panicle, with numerous small greenish heads. Wild on banks and plains in the northern part of the country.

3. filifòlia, Torr. Shrubby, canescent, 3 ft. or less high, very leafy, the branches rigid: lvs. 3-parted into linear filiform segms., scarcely $\frac{1}{16}$ in. wide: panicle long and leafy. Plains, W.—Plant has a purplish, mist-like aspect when in fr.

BB. *Disk-fls. perfect and fertile; style 2-cleft.*

C. *Receptacle hairy.*

D. *Racemes not 1-sided.*

4. frígida, Willd. Herb, 8–12 in., with a woody base, silvery canescent: lvs. much cut into linear lobes: heads small and globular, with pale involucre, in numerous racemes. Plains and mts. W. Intro. 1883.—Good for borders. Known in Colo. as "mountain fringe," and used medicinally.

5. seríce a, Web. Sub-shrub or more usually a creeping woody perennial with finely divided silky foliage: lf.-segms. distinctly stalked: fl.-heads in solitary or paniculately branching racemes, yellowish white. Summer. Siberia.

6. argéntea, L'Her. Shrubby, erect, 1–2 ft.: lvs. white-silky, 2-pinnate, the lobes linear or lanceolate: heads globular, tomentose, nodding, in racemose panicles. Madeira.—Useful for rockwork.

7. Absínthium, Linn. Wormwood. Absinthium. Almost shrubby, 2–4 ft. high, spreading and branchy, white-silky: lvs. 2–3-parted into oblong, obtuse lobes: heads small and numerous, in leafy panicles.—Wormwood is native to Eu., but it occasionally escapes from gardens. It is a common garden herb, being used in domestic medicine, especially as a vermifuge. Wormwood tea is an odorous memory with every person who was reared in the country. See *Absinthe* and *Wormwood*.

DD. *Racemes 1-sided.*

8. arboréscens, Linn. Shrubby, 1–2 ft., the sts. erect and angled: foliage finely dissected, silvery white, the upper lvs. almost sessile, the lower petiolate: fls. in somewhat 1-sided racemes, bright yellow. Medit. region.—Hardy only as far north as Washington, D. C.

CC. *Receptacle not hairy.*

D. *Lvs. white or silvery throughout.*

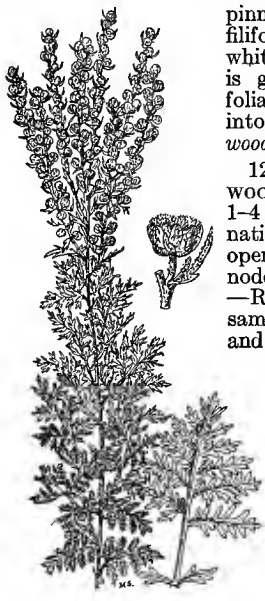
9. Stelleriàna, Bess. (*A. endoviciàna*, Hort.). Old Woman. Dusty Miller. Beach Wormwood. Fig. 385. Herb, 2 ft., from a woody creeping base, densely white tomentose: lvs. pinnatifid, with obtuse lobes: heads large and many-fld., in a racemose-glomerate infl. N. E. Asia and on the Atlantic coast from Mass. to Del.—Attractive from its whiteness. Useful for borders.

10. Purshiàna, Bess. (*A. gnaphalòdes*, Nutt. not Hort.). Sts. and lvs. white-woolly on both sides, differing from *A. ludoviciana* in which the lvs. are usually glabrate above when old: lvs. acute or acuminate, overtopped by the spicate-paniculate infl. of white fls. Missouri R. to the Pacific.

386. Artemisia pontica. (×½)

DD. *Lvs. white on 1 side only or green throughout.*

11. **Abrótanum,** Linn. SOUTHERNWOOD. OLD MAN. Shrubby, 3–5 ft., green and glabrous, the st. much branched and rather strict: lvs. 1–3-pinnately divided, the divisions fine-filiform: panicle loose, with yellowish white heads. Eu.—Southernwood is grown for its pleasant-scented foliage; and it sometimes escapes into waste places. See *Southernwood.*



387. Artemisia vulgaris. (×⅛)

12. **póntica,** Linn. ROMAN WORMWOOD. Fig. 386. Shrubby, erect, 1–4 ft.: lvs. canescent below, pinnatisect, the lobes linear: panicle open and long, with small, globular, nodding, whitish yellow heads. Eu. —Roman wormwood is used for the same purposes as *A. Absinthium,* and is more agreeable. A source of absinthe.

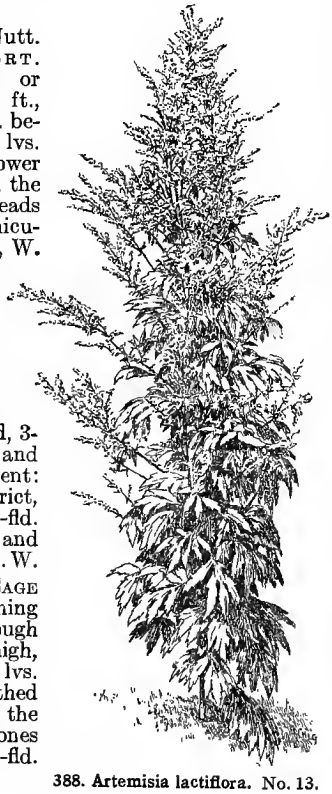
13. **vulgáris,** Linn. MUGWORT. Fig. 387. Herb, erect, paniculately branched, the sts. often purplish: lvs. white-cottony beneath but soon green above, 2-pinnately cleft, with lanceolate lobes; upper lvs. sometimes linear: heads many, oblong, yellowish. Eu. and N. N. Amer., and naturalized in eastern states.—A white-fld. form has been sold as *A. lactiflòra.* Fig. 388. It is a beautiful plant with fragrant foliage. G. 29:409.—Mugwort is grown for the ornament of its foliage. There are variegated-lvd. and golden-lvd. varieties. It was once a domestic remedy. Variable.

14. **ludoviciàna,** Nutt. WESTERN MUGWORT. WHITE SAGE. Erect or ascending herb, 2–3 ft., white-tomentose or lvs. becoming greenish above: lvs. linear to oblong, the lower ones toothed or parted, the upper ones entire: heads small, bell-shaped, paniculate. Plains and banks, W. Intro. 1891.

AA. *Heads with perfect fls. throughout: receptacle not hairy.*

15. **arbúscula,** Nutt. SAGE BRUSH. Shrubby, a foot or less high: lvs. short, wedge-shaped, 3-lobed, the lobes obovate and often 2-lobed, canescent: panicle simple and strict, often spike-like, the 5–9-fld. heads erect. Plains and mts., Colo. and Wyo., N. W.

16. **tridentàta,** Nutt. SAGE BRUSH. Shrubby, reaching height of 12 ft. although often only a foot high, branchy, canescent: lvs. wedge-shaped, 3–7-toothed or lobed, truncate at the summit, the uppermost ones narrower: heads 5–8-fld. Plains, W. Intro. 1881.



388. Artemisia lactiflora. No. 13.

17. **sacrórum,** Ledeb. Annual or biennial, shrubby below: lvs. long-petioled, ovate, pinnatisect and the segms. again pectinate, hoary or white-pubescent, the rachis winged: fls. 15–20 in the head, the heads nodding and in separate slender racemes. S. Russia, Siberia, etc. Var. **víride,** Hort., with green foliage, is the attractive SUMMER FIR recently intro., grown as an annual for its neat pyramidal form (3–5 ft.) and much dissected rich green foliage.

A. Baümgartenii, Bess. Compact, shrub-like, with small lvs. and yellow fls. standing erect above the lvs. S. Eu.—*A. landta,* Willd (A. pedemontana, Balbis). Low cespitose plant with finely cut, silvery foliage for which it is chiefly grown. Spain.

N. TAYLOR.†

389. Globe artichoke.

ARTHROPÒDIUM (Greek, *joint* and *foot,* alluding to jointed pedicels). *Liliàceæ.* Herbaceous perennials, allied to Anthericum, grown in the open in the South and otherwise in greenhouses.

Tufted herbs 1–3 ft. high, with fibrous fleshy roots: lvs. linear or lanceolate, crowded at base of st.: scape simple or branched; fls. white or violet, in racemes or panicles, on pedicels jointed at the middle; perianth persistent, the segms. 6 and distinct and 3-nerved; stamens 6, shorter than perianth: fr. a subglobose caps., 3-valved.—About 10 species in Austral., New Zeal., etc. Cult. and prop. as for Anthericum, requiring no special treatment.

cirrhàtum, R. Br. Glabrous, to 3 ft.: lvs. numerous, deep green, 2 ft. or less long: scape stout, naked, bearing a much-branched panicle often 1 ft. long; fls. white, star-shaped, 1 in. or less in diam., the segms. oblong-lanceolate, acuminate; filaments bearing 2 tendril-like appendages (whence the name). New Zeal. B.M. 2350.—Reported in S. Calif. L. H. B.

ARTHROTÁXIS: *Athrotaxis.*

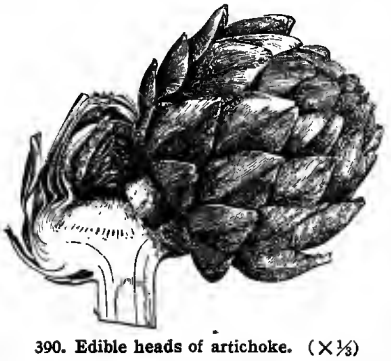
ARTICHOKE (*Cýnara Scólymus,* Linn.). *Compósitæ.* The artichoke (or the Globe artichoke, to distinguish it from the Jerusalem artichoke) is a strong thistle-like plant (Fig. 389), grown for the edible flower-heads (Fig. 390). It is native in southern Europe and northern Africa, and is not hardy in the northernmost parts of the United States. It is perennial, but the plantation should be renewed every two or three years. See *Cynara.*

The artichoke is propagated by seed or by suckers. The latter is the preferable method, for a good strain or variety may thus be perpetuated. The buds or shoots are detached from the old crown in spring before growth begins. Seeds produce bearing plants the following year, although heads may be secured the same autumn if the season is long and if the seeds are started early under glass.

The soft fleshy receptacle of the flower-head and the thickened base of the scales (or involucre bracts)

are the edible parts. They are sometimes eaten raw, but are usually boiled and served with drawn butter or sauce. The leaves are sometimes blanched after the manner of sea-kale and cardoon, and are cooked as a pot-herb.

In the southern states and California, the artichoke is grown without difficulty. In California, particularly, it thrives as a field crop. In northern gardens, even professional and skilled gardeners have usually given it up after a few trials. It is found in a few gardens on Long Island, in Massachusetts, and perhaps a few other places, and is there grown with fair success, provided that the crown is protected in winter in such a way that snow or heavy mulch is not allowed to choke the plant. This seems to be the chief danger.



390. Edible heads of artichoke. (×⅛)

Instead of covering with manure or litter, place a cap or miniature tent over the crown to give it air and freedom of breathing. The flower-heads are now regularly and commonly found on sale at the green grocers' in our larger eastern cities, and the supply comes mostly from California. The large seeds may need special treatment to make them germinate promptly. The better way, undoubtedly, for the home gardener who may wish to try a few plants, is to secure sucker plants from one of the big seedsmen or professional plant-growers. Set them in fairly good warm soil, 3 feet each way, or 4 by 2, and give clean cultivation. Protect the crowns during winter as suggested, and in following spring thin to about three shoots. Edible heads may be expected in July. They are gathered for use before the flower-heads open. It is better to cut the old stalk down to the ground after the head is removed, for the root is not then weakened and new shoots will spring up. There are a number of varieties, Large Green Paris being the one mostly mentioned in California. In parts of Europe the artichoke is grown with special skill, but it has never been a prominent vegetable in American gardens.

T. Greiner.

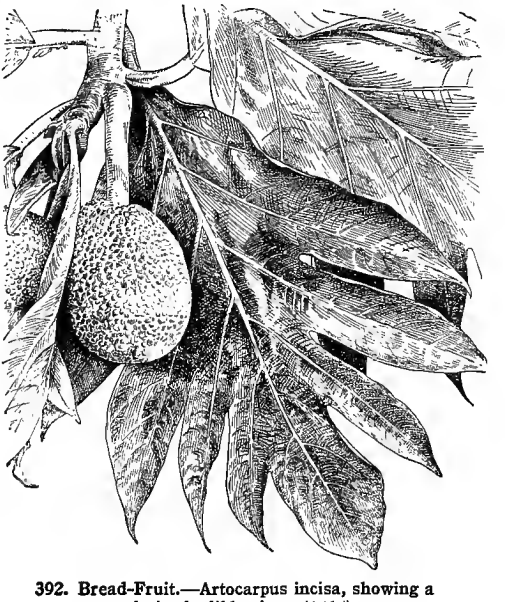
ARTICHOKE, JERUSALEM (*Helianthus tuberosus*, Linn.). *Compositæ*. The Jerusalem artichoke is the subterranean stem tuber of a native sunflower. Fig. 391. The plant is coarse and upright, and persists as a weed when once introduced. It does not need excessively rich soil, nor high culture, succeeding on any warm well-drained land without attention. It is planted much after the manner of potatoes, and it will grow and produce its many smallish, white, edible tubers. In late fall, the plants may be pulled up, exposing to view the tubers that are clustered around the roots near the main stalks so that they can be easily gathered with the help of a hoe or potato hook, if wanted for use as a culinary vegetable; or, if grown for hog-feed, the hogs may be turned right into the field and allowed to dig their own. All farm stock seems to like the artichoke tubers. If shredded or ground and mixed with meals, they make a good winter ration, as a variety, for poultry. More prolific than common potatoes, and far more easily grown, the artichoke is one of the crops that may be considered for cultivation as a succulent vegetable to feed to cattle, swine, and other farm animals during winter. Raw or boiled and served cold with oil and vinegar, this tuber also makes a very palatable winter or spring salad, and for this purpose it finds a limited sale in our markets. The chief commercial demand for it is for seed purposes. Frost has no injurious effect on the tuber in the ground, and the easiest way to winter it, therefore, is by leaving the plants alone until spring and then digging the tubers. If already harvested, they may be pitted like potatoes, beets, or other roots, and will require very little covering. Mammoth White French is said by some propagators to be an improved strain of the Jerusalem artichoke. If there is danger of the plant spreading and becoming a weed, hogs, when given a chance at it, will soon clear the land of the tubers. It was cultivated by the Indians. See *Helianthus*.

T. Greiner.

391. Tuber of Jerusalem artichoke. (×¼)

ARTOCÁRPUS (*artos*, bread, and *carpos*, fruit). *Moràceæ*. Bread-Fruit. Milky-juiced tropical trees, some of them yielding edible fruits, ornamental in foliage.

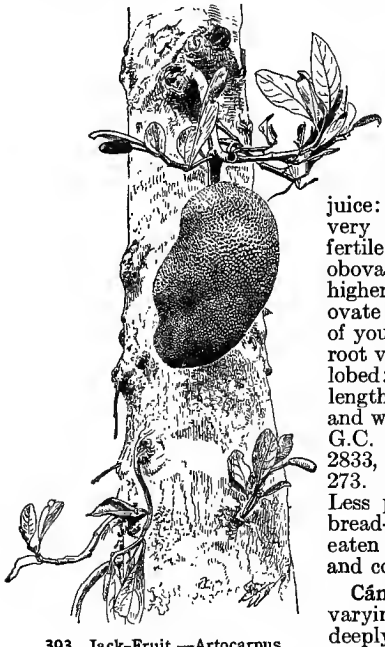
Leaves alternate, large, thick, entire or pinnate: dicœcious; staminate fls. on long spikes, the sepals and stamens 2; pistillate fls. in globular heads, with simple 1-ovuled ovary and bifid stigma: fr. a large fleshy mass or syncarp, formed of the aggregated fls.—A genus of 40 species containing many tropical fr. plants, originally from the E. Indies, sometimes cult. with difficulty in northern botanic gardens for their great economic interest, and throughout the world in the tropics. They need a hot, moist atmosphere, much water, and perfect drainage. Prop. slowly by cuttings of young lateral growth. Bread-fruit seeds are boiled and eaten.



392. Bread-Fruit.—Artocarpus incisa, showing a fruit of edible size. (×⅛)

incìsa, Linn. f. (*A. commùnis*, Forst.?). Bread-Fruit. Fig. 392. Tree, 30–40 ft., with a viscid, milky juice: branches fragile: lvs. 1–3 ft. long, leathery, ovate, cuneate and entire at base, upper part 3–9-lobed: male fls. in a dense club-shaped yellow catkin, 10–16 in. long; female fls. in a subglobular echinate head, having a spongy receptacle: fr. 4–6 in. diam., typically muricated, but in the best cult. varieties reticulated only, and often seedless. Gt. 39, p. 273. Gng. 5:233, and

B.M. 2869–2871, where the romantic story of its transfer to the W. Indies is told.—Sparingly cult. in S. Fla. and in warmhouses of botanic gardens. Eaten cooked, as a vegetable rather than as a fruit; widely used in tropics.



393. Jack-Fruit.—Artocarpus integrifolia.

integrifòlia, Linn. f. JACK-FRUIT or TREE. Called also JACA. Fig. 393. Tree, 30 ft., with milky juice: lvs. 4–6 in. long, very various; those of fertile branches nearly obovate, entire; those of higher branches more obovate and oblong; those of young shoots from the root very narrow, or 2–3-lobed: fr. attaining a length of 18 in. or more, and weight of 30–40 lbs. G.C. III. 20:717. B.M. 2833, 2834. Gt. 39, p. 273. Gn. 35, p. 455.—Less palatable than the bread-fruit, and usually eaten only by natives and coolies.

Cánnonii, Bull. Lvs. varying from cordate to deeply 3-lobed, 1 ft. long, red beneath, bronzy crimson and purple above, very showy. Society Isls. F.S. 21:2231, 2232.—Perhaps better included under *Ficus Cannonii*, according to Nicholson, but here retained in Artocarpus.

N. TAYLOR.†

ÁRUM (ancient name). *Aràceæ.* WILD GINGER. Tuber-bearing low herbs, of few species, in Eu. and W. Asia, most of them grown in pots.

Lvs. simple, the petiole sheathed at the base: spathe convolute, variously colored, mostly including the short spadix; pistillate fls. at the base. Monogr. by Engler in DeCandolle's Monographiæ Phanerogamarum, Vol. II.

Arums are grown usually as oddities, mostly under the general name of callas. Some of the species are hardy; others, as *A. palæstinum*, are tender, and require glass-house treatment. The kinds are managed in essentially the same way as the fancy-leaved caladiums. Plant the tubers sufficiently deep that roots may form from near the top. Give rich soil, and water freely when growing or in bloom. The hardy species should be well mulched in late fall. They thrive best in partially shaded places and in rich soil. Propagation is by natural offsets; also by seeds or berries, which some species produce freely. Some of the species are acrid-poisonous.

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angustatum, 6.
byzantinum, 7.
canariense, 7.
concinnatum, 7.
corsicum, 1.
cylindraceum, 7.
cyprium, 2.
detruncatum, 3.
Dioscoridis, 2.
elongatum, 5.
gratum, 5.
immaculatum, 6.
intermedium, 6.
italicum, 7.
maculatum, 6.
Malyi, 6.
marmoratum, 7.
nigrum, 5.
Nordmannii, 5.
orientale, 5.
palæstinum, 4.
pictum, 1.
sanctum, 4.
spectabile, 2.
syriacum, 2.
variolatum, 5.
vulgare, 6.
Zelebori, 6.

A. *Mature lvs. cordate, oblong-ovate.*

1. **pictum,** Linn. f. (*A. córsicum*, Loisel). Lvs. appearing in spring, long-petioled, light green: spathe bright violet, swollen at the base: spadix purple-black, exceeding the spathe. Corsica, Balearica, etc.—Hardy.

AA. *Mature lvs. hastate or sagittate.*

B. *Tuber round-flattened or oblate, the lvs. and peduncles arising from a depressed center: lvs. appearing before the spathe.*

2. **Dioscorìdis,** Sibth. & Smith (*A. spectábile*, Regel. *A. syrìacum*, Blume. *A. cýprium*, Schott). Lf.-blade oblong-triangular or ovate-triangular: spathe-tube pale within, the limb 6–8 in. long, lanceolate-oblong, and colored with large lenticular purple spots: spadix short, included. Asia Minor.—Runs into many forms, with variously marked spathes. Pots.

3. **detruncàtum,** Mey. Lvs. more or less truncate at the base, the blade shorter than in the last: spathe yellowish green and purple-spotted, large (10–15 in. long) and short-stalked, the limb acuminate. Persia. —Hardy.

4. **palæstìnum,** Boiss. (*A. sánctum*, Hort.). BLACK CALLA. SOLOMON'S LILY. Lvs. cordate-hastate, 6 in. broad across the base and about equal in length, the middle lobe broad-ovate and nearly blunt: spathe about the length of the lf., with a short green tube, and an elongated lance-oblong tapering limb, which is greenish on the outside and continuous black-purple within, the tip sometimes recurving: spadix shorter than the spathe, the upper part dark-colored. Palestine. B.M.

394. Arum maculatum. (×⅓)

5509. Gn. 45, p. 311; 59, p. 317; 71, p. 102.—Perhaps the most popular arum at present, being grown in pots as an oddity.

5. **orientàle,** Bieb. A foot high: lvs. brownish, broadly hastate-sagittate, the front lobe oblong-acute: spathe-tube oblong-ovoid and white within, the limb ovate to oblong and intense black-purple (rarely pale), resembling *A. maculatum*.—A hardy species from Asia Minor, running into many forms. Some of the plants

referred here are *A. nigrum*, *A. variolatum*, *A. Nordmannii*, *A. gratum*, Schott; *A. elongatum* and *A. albispathum*, Ster. (not *A. albispathum*, Hort., which is *A. italicum*).

BB. *Tuber ovoid or oblong, propagating horizontally, the lvs. and peduncles arising from the apex: lvs. appearing before or with the spathe.*

6. maculàtum, Linn. (*A. vulgàre*, Lam.). LORDS-AND-LADIES. CUCKOO-PINT. WAKE ROBIN (in England). Fig. 394. About a foot high: lvs. usually black-spotted, hastate or sagittate, the front lobe triangular-ovate, about as high as the spathe: spathe somewhat contracted above the base, the margins of the limb becoming inrolled, spotted with purple: spadix shorter than the spathe, purple. Eu.—A hardy species, of many forms. A form with spotless lvs. and whitish tube with medial purple zone, is *A. immaculàtum*, Reichb., and *Zelebòri*, Schott. Var. **angustàtum,** Engler (*A. intermèdium*, Schur. *A. Mályi*, Schott) has a narrow light purple spathe. Var. **alpìnum,** Engler (*A. alpìnum*, Schott & Kotschy) has peduncles longer, and an ovate-lanceolate spathe.

395. Arum italicum. (×¼)

7. itálicum, Mill. (*A. cylindràceum*, Gasp.). Fig. 395. Larger than the last: lvs. hastate, nearly truncate below, light-veined: spathe scarcely swollen below, the limb erect and not expanding and including the short spadix (tip sometimes deflexed after flowering), yellowish or white and faintly striate. Eu. B.M. 2432.—A hardy species; also grown in pots. In the open, the lvs. appear in the fall. A very variable species. Var. **canariénse,** Engler (*A. canariénse*, Webb & Berth.), has narrow lf.-lobes and spathe. Var. **concinnàtum,** Engler (*A. concinnàtum* and *A. marmoràtum*, Schott), has broad gray-spotted lvs. Var. **byzantìnum,** Engler, (*A. byzantìnum*, Schott), has spathe-tube oblong, white inside and purple at the mouth, and an acuminate purple or green limb. Var. **albispàthum,** Hort., has a white spathe. L. H. B.

ARÚNCUS (old name). *Rosàceæ*. GOAT'S-BEARD. Ornamental tall perennial herbs, cultivated chiefly for the large showy panicles of white flowers and also for the handsome much-divided foliage.

Leaves bi- to tripinnate with minute or wanting stipules: fls. dicœcious, small; calyx 5-lobed; petals 5; stamens many; pistils commonly 3: the follicles dehiscent, glabrous, usually 2-seeded; seeds minute, dull.—Two species in N. Amer., N. and W. Eu., N. Asia to Japan. Formerly usually referred to Spiræa, which differs chiefly in its shrubby habit, simple, rather small lvs., and 5 pistils.

They are tall perennial herbs with large compound leaves and small white flowers in slender spikes forming large terminal panicles. The species in cultivation is hardy North; it prefers rich rather moist soil and grows well in half-shady situations. Propagation is by seeds, which germinate readily, and also by division of older plants.

sylvéster, Kostel. (*A. Arùncus*, Karsten. *Spirèa Arúncus*, Linn.). Tall (5–7 ft.), erect branchy herb: lvs. large, 2–3-pinnate; lfts. ovate to lanceolate, sharply and doubly serrate, 1–2½ in. long: fls. about ⅛in. across: follicles deflexed in fr. May–July. Rich woods, N. Amer., N. Eu. and Asia.—A desirable hardy border plant of easy cult. Var. **Kneiffii,** Zabel. Lfts. linear-lanceolate, irregularly serrate or incised, long-acuminate: fls. as in the type. M.D.G. 1897:260.—Very graceful form with its finely cut foliage.

A. astilboìdes, Maxim. (Spiræa Aruncus var. astilboides, Maxim.). Similar to the preceding, but lower and smaller in every part: lfts. more deeply serrate, ¾–1½ in. long: infl. less compound, with denser oblong branchlets: follicles erect. Japan.—Apparently not in cult.; the plant cult. under the name of Spiræa astilboides is Astilbe astilboides, Lem., which is a true astilbe.

ALFRED REHDER.

ARUNDINÀRIA: *Bamboo.*

ARÚNDO (an ancient Latin name for *A. Donax*). *Gramineæ*. REED. Tall reed-like grasses with broad flat blades and large plume-like terminal panicles: spikelets 3–4-fld.; glumes narrow, acute; rachilla naked; lemmas long-pilose.—Species about 6, in the warmer regions of the Old World.

Dònax, Linn. GIANT REED. Figs. 396, 397. Tall and stout, as much as 20 ft., from large knotty rootstocks: blades numerous, cordate-clasping and hairy-tufted at base, 2–3 in. wide on main st.: panicle 1–2 ft.; spikelets 6 lines long. G. 2:419. Gn. 1, p. 391; 3, p. 493; 8, p. 199; 17, p. 407; 27, p. 307. G.M. 50:253. G.W. 2:337; 3:416; 8:613.—Cult. for ornament because of the regularly placed lvs. and the large plumes. A smaller less hardy variegated form with white-striped lvs. is cult. under the name of var. **variegàta** (var. *versìcolor;* var. *pìcta*). G. 18:137. Var. **macrophýlla** has large glaucous lvs.

conspícua, Forst. f. Sts. lower and more slender: blades long and narrow, 2–4 ft.: panicle 1–2 ft., silvery or yellow-white; spikelets 1–3-fld. B.M. 6232. F. 1874:61. G. 1:344; 9:64; 19:21. Gn. 49, p. 229; 66, p. 121. G.M. 55:408. G.W. 15:51. Native of New Zeal.—Less hardy than *A. Donax*. A. S. HITCHCOCK.

ÁSARUM (ancient obscure name). Including *Hexastylis*. *Aristolochiàceæ*. ASARABACCA. Low, nearly stemless herbs, sometimes planted in wild borders and used as ground-cover in shady places.

Perennial: sts. creeping, with odd purplish or brown fls. on the surface of the ground (or nearly so), underneath the heart-like or kidney-like lvs.: corolla wanting or merely rudimentary, but calyx corolla-like, with a regular 3-parted limb; stamens 12, with tips on the filaments projecting beyond the anthers: ovary inferior, maturing into a rather fleshy globular caps.—A dozen or more species in the temperate parts of the northern hemisphere. The asarums inhabit rich, shady woods, spreading on the ground, and the fls. are unseen except by the close observer. They are of easy culture if transplanted to rich, moist places. They make attractive carpets in borders and groves. The species described are sold by dealers in native plants. Some of the species are reported to have medicinal properties. Several species of doubtful validity have been described from the southern states.

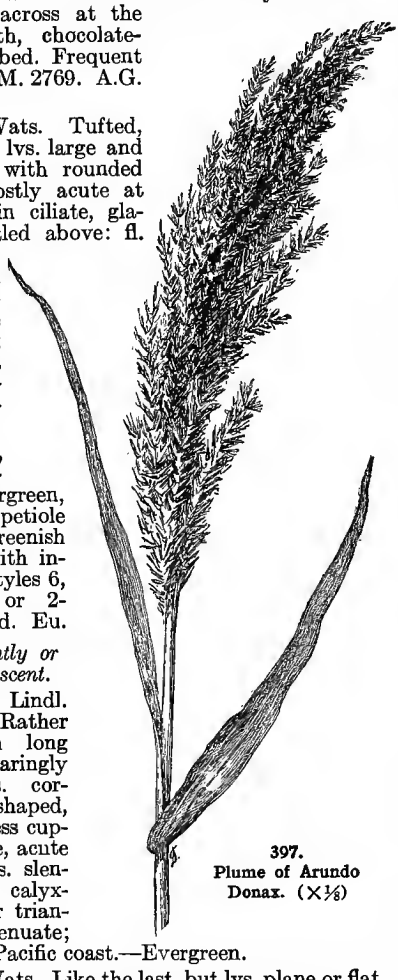
396. Arundo Donax.

A. *Plant markedly pubescent.*

canadénse, Linn. WILD GINGER. CANADA SNAKE-ROOT. Lvs. about 2 to a plant, thin, kidney-shaped, pointed, with a deep and open sinus, not mottled: fl. slender-stalked, with lance-acuminate calyx-lobes an inch or more across at the expanded mouth, chocolate-brown; style 6-lobed. Frequent in woods E. B.M. 2769. A.G. 13:517.

Hártwegii, Wats. Tufted, loose-pubescent: lvs. large and thick, cordate, with rounded basal lobes, mostly acute at the apex, margin ciliate, glabrous and mottled above: fl. stout-stalked, the lobes often ovate and long-pointed, the ovary inferior; styles 6. Sierra Nevadas, 4,000–7,000 ft. altitude.

europæ̀um, Linn. Lvs. kidney-shaped, evergreen, dark green, the petiole 3–5 in.: fls. greenish purple, ½in., with incurved lobes; styles 6, and grooved or 2-parted, recurved. Eu.



397. Plume of Arundo Donax. (×⅛)

AA. *Plant slightly or not at all pubescent.*

caudàtum, Lindl. WILD GINGER. Rather slender, with long rootstocks, sparingly pubescent: lvs. cordate-kidney-shaped, and more or less cupped or cucullate, acute or obtusish: fls. slender-stalked, the calyx-lobes oblong or triangular and attenuate; styles united. Pacific coast.—Evergreen.

Lémmonii, Wats. Like the last, but lvs. plane or flat, rounded at apex, less pubescent, calyx-lobes short. Sierra Nevadas.

virgínicum, Linn. Lvs. broad-ovate or orbicular, rounded at the top, the sinus narrow: fl. short-stalked, purple, the calyx-lobes broad and rounded; styles 6, 2-lobed; anthers not pointed. Va., S. in mts.

arifòlium, Michx. Lvs. thickish and usually mottled, orbicular to hastate, obtuse: fls. stout-stalked, urn-shaped and much contracted at the throat; styles 6, 2-lobed; anthers pointed. Va., S. L. H. B.

ASCLÈPIAS (ancient Greek and Latinized name). *Asclepiadàceæ.* MILKWEED. SILKWEED. Perennial milky-juiced herbs, sometimes used in the hardy border or wild garden.

Erect, with deep thick and hard perennial roots: lvs. opposite or verticillate (rarely alternate), entire: fls. gamopetalous, the corolla segms. generally strongly reflexed; stamens 5, attached to the corolla, the anthers more or less united about the stigma; between the corolla and the stamens is a crown of 5 cornucopia-like horns or appendages; pollen cohering into a waxy mass (pollinium) which is removed bodily by insects that visit the fl.: fr. 2 warty, or echinate or smooth follicles. The pollination of an asclepias fl. is shown in Fig. 398. The pollen-masses are usually twin (as at *b*), and the handle or caudicle lies in a chink on the side of the stigma. The pollen-masses become attached to the legs or mouth parts of the insect, and are thereby transferred to another fl.—The milkweeds are common in waste places in N. Amer., and are rarely cult. About 80 species are known, mostly North American, but others in Cent. and S. Amer. and Afr. Several species (described below) have been offered by dealers in native plants. The butterfly-weed and some others are very showy and worthy of more general attention. The large-lvd. kinds are desirable when heavy foliage effects are wanted. They are all perennials of the easiest cult. Prop. by division, rarely by seeds.

A. *Fls. (corolla and crown) orange.*

tuberòsa, Linn. BUTTERFLY-WEED. PLEURISY ROOT. Fig. 399. Hairy, 2–3 ft. high, from long, horizontal roots, with more or less alternate, lance-oblong or lance-linear lvs.: umbels several, short-peduncled: pods pubescent, erect. Dry banks and fields; widespread, and not infrequent. B.R. 76.—A handsome plant.

AA. *Fls. in shades of red or purple.*

Curassávica, Linn. Plant glabrous, 2 ft. or less: lvs. opposite and short-petioled, thin, oblong-lanceolate: corolla scarlet: pods glabrous, erect. Fla. and La. B.R. 81.

incarnàta, Linn. Glabrous or nearly so, leafy and branching, 3 ft.: lvs. opposite, oblong-lanceolate: corolla rose-purple to flesh-color, with oblong lobes: pods glabrous, erect. B.R. 250. Var. **púlchra,** Pers. Hirsute, and lvs. broader. Swamps.—Common.

AAA. *Fls. greenish, yellowish or white (sometimes purple-tinged, especially in A. quadrifolia).*

B. *Pods tomentose and soft-spiny.*

speciòsa, Torr. (*A. Douglasii,* Hook.). St. stout and simple, 3 ft. or less, fine-tomentose or becoming glabrous: lvs. large and broad, ovate, transversely veined, short-petioled: fls. purplish and large, the peduncle of the umbel shorter than the lvs. Neb. W. and S. B.M. 4413.

Cornùtii, Decne. (*A. syrìaca,* Linn.). Differs from last in having obtuse and short hoods to the crown, taller, less pubescent: lvs. oblong or oval: fls. dull purple, in large, more or less nodding umbels. Mn. 7:221.—The common milkweed of the eastern states.

BB. *Pods glabrous and unarmed.*

C. *Fruiting pedicels decurved or deflexed, the pods erect or ascending.*

amplexicaùlis, Michx. Plant glabrous and glaucous: st. decumbent, 1–2 ft. long: lvs. numerous, cordate-ovate and clasping, obtuse, succulent: corolla green-purple. Barrens, N. C. and S.

phytolaccoìdes, Pursh (*A. nìvea,* Sims). Plant glabrous and green, 3–4 ft., erect: lvs. thin, oval to lance-oval, acuminate and short-petioled: fls. greenish, in large, loose umbels. Moist ground; frequent. B.M. 1181.

398. Milkweed flower, showing pollination.

Hállii, Gray. Stout, puberulent: lvs. thickish, ovate-lanceolate or oblong (3–5 in. long), short-petioled: fls. greenish white and purple, in few many-fld. umbels. Colo. G.C. III. 28:183.

variegàta, Linn. Two ft. or less high: lvs. 3–7 pairs, oval, ovate or oblong, thinnish, green and glabrous above and pale beneath: fls. white and pink, in 1–3 umbels. Dry, shady places, central and southern states. B.M. 1182.

eriocárpa, Benth. Densely woolly all over: lvs. alternate or in 3's, long-oblong or lanceolate, short-petioled: fls. dull white, in few or several umbels. Calif.

cc. *Fruiting pedicels erect, and the pods erect.*

quadrifòlia, Linn. About 2 ft., not branched, with lvs. towards the top of the st. in whorls of 4: lvs. ovate or lance-ovate, acuminate, thin, nearly or quite glabrous: fls. pink to white in 2–4 loose umbels. Dry soil; frequent. L.B.C. 13:1258.

verticillàta, Linn. About 2 ft., slender, very leafy: lvs. in whorls of 3–6, very narrow-linear and revolute: fls. greenish white, in many small umbels. Dry soil; frequent. L.B.C. 11:1067.

Var. **pùmila,** Gray. A few inches high from a fascicled root: lvs. filiform, crowded. Plains, W.

mexicàna, Cav. Height 5 ft. or less: lvs. in whorls of 3–6, or sometimes opposite or fascicled, linear or narrow-lanceolate: fls. greenish white or purplish in dense, many-fld. umbels. Ore., W. and S. L. H. B.

399. Asclepias tuberosa. (×⅓)

ÁSCYRUM (Greek, *not hard* or *rough*, ancient name of some plant). *Hypericàceæ.* Small plants sometimes planted in wild gardens and borders.

Low herbs or subshrubs, with bright yellow fls., 2 small sepals and 2 large ones, 4 petals, and many stamens: fr. a 1-celled and 2–4-valved caps.—Two species in dry, sandy soils in eastern states (also one or two W. Indian and one Himalayan species). Of easiest cult. but should be covered in winter in the N. Prop. by division; also by seeds.

hypericoìdes, Linn. (*A. Crúx-Andreæ,* Linn.). St. Andrew's Cross. Fig. 400. A ft. or less high, branchy: lvs. thin, oblong or obovate, narrowed to the base: petals linear-oblong; styles 2, short. G.F. 5:257 (adapted in Fig. 400). Mn. 3:65.

stáns, Michx. St. Peter's-wort. Taller, scarcely branched: st. 2-edged, stout: lvs. thicker, broad-oblong or oval and clasping: petals obovate; styles 3–4. L. H. B.

ASH: *Fraxinus.*

ASÍMINA, (from *Assiminier,* a French-and-Indian name). *Annonàceæ.* Papaw (the papaw of literature is Carica, which see). Small trees or shrubs, grown chiefly for their handsome large foliage and for their attractive flowers; also sometimes for their edible fruit.

Low shrubs, and 1 species a small tree: lvs. alternate, usually deciduous, entire: fls. axillary, solitary or few, nodding, short-stalked; sepals 3, smaller than petals,

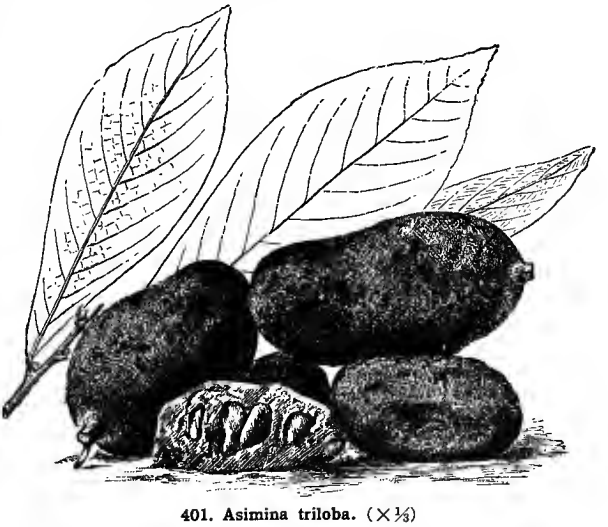
400. Ascyrum hypericoides. (×½)

deciduous; petals 6, the inner ones smaller, usually upright; stamens numerous, crowded, with short filaments; pistils 3–15, separate, 1-celled with many ovules: fr. consisting of 1 or few oval to oblong berries with rather large compressed seeds in 1 or 2 ranks.—Eight species in E. N. Amer. Description of all species is given in Gray, Syn. Fl. N. Amer. 1, pt. 1, pp. 62 and 464.

Asiminas are ornamental trees or shrubs with handsome large foliage, of disagreeable odor when bruised, conspicuous white or purplish flowers in early spring and large edible fruits in autumn. Only two species are cultivated, of which the arborescent one is the hardier and the handsomer in foliage, while the more tender *A. grandiflora* has larger and showier flowers.

They grow best in rich and moist soil. They transplant with difficulty. Propagation is by seeds sown in autumn, or stratified and sown in spring, or by layers in autumn; also by root-cuttings. In the North, the seeds should be sown in pots or pans.

tríloba, Dunal (*Annòna tríloba,* Linn.). Fig. 401. Small tree, 10–40 ft.: lvs. cuneate, obovate-oblong, acute, ½–1 ft. long, glabrous: fls. with the lvs. from branches of the previous year, green when expanding, changing to purplish red, with yellow in the middle, 2 in. broad: fr.



401. Asimina triloba. (×⅓)

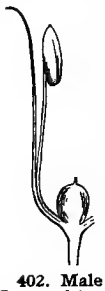
oblong, 2–6 in. long, dark brown. S. states, north to N. Y., west to Mich. and Kan. S.S. 1:15, 16. B.M. 5854. Gn. 33, p. 321. G.F. 8:495. A.G. 44:713. R.H. 1911, pp. 134, 135.—This is the only arborescent species of the genus. It is well worth a place in the garden, for its large foliage is very handsome and the fls., appearing in the early spring, are attractive. The large fr. is edible, and may be still improved by cult. and careful selection of the best varieties. Many persons do not relish the highly aromatic flavor; and the large seeds are a disadvantage. The tree has proved hardy in Mass. and Ont. One or 2 named forms have been offered.

grandifl̆ora, Dunal. Shrub, 2–6 ft.: lvs. cuneate, obovate or oblong, obtuse, 2–4 in. long, rufous-pubescent when young, at length glabrous and chartaceous: fls. large, appearing with the lvs.; outer petals cream-colored, over 2 in. long, much larger than the inner ones: the large fr. is said to be very delicious. S. Ga., Fla.

ALFRED REHDER.

ASPÁRAGUS (the Greek name). *Liliàceæ*. ASPARAGUS. SMILAX (greenhouse). ASPARAGUS FERN. A large genus of herbaceous perennials and tender woody shrubs and vines, grown mostly for ornamental habit and foliage, but one of them (*A. officinalis*) for food.

Plants provided with short underground rhizomes from which the aërial sts. arise in serial order: roots often tuberous, sometimes fleshy but long-cylindric as in *A. officinalis:* sts. varying from low herbs to stout woody vines 50 ft. or more long: lvs. reduced to scale-like bracts usually with a basal spur, often spiny; lf.-function performed by special sterile twigs, cladodes (phyllodia, cladophylls, i.e., lf.-like branchlets) of determinate growth and of characteristic shape with each species (see Fig. 411): fls. usually axillary, or terminal, in 1–4's, sometimes umbellate, often racemose on special branches lacking the cladodes, small; perianth 6-parted; stamens 6, free, filament attached to base of perianth lobes; ovary 3-celled, stigma 3-parted (except in Section Kodiastigma), ovules 2–6 in locule: fr. a berry 1-, 3-, 6- or more seeded; seed globose or flat on one side, testa usually black, embryo straight, surrounded by a hard endosperm.—About 150 species, all native of the Old World, ranging from Siberia to Cape of Good Hope, usually from dry regions. Monogr. by Baker, Journ. Linn. Soc. 14 (1875); account of cult. species by Watson, G.C. III. 23:122, 147, 178.



402. Male flower of Asparagus officinalis. Typical of Euasparagus. The rudimentary ovary is shown.

This large genus is remarkable for its lack of functional leaves, whose place is taken by the leaf-like cladodes which are usually considered as leaves. The cladodes are usually borne in fascicles of three to forty in the axils of the leaf-scale; in *A. asparagoides* the leaf-like cladode is solitary in the axils. The woody members of the genus often have the base of the leaf-scale developed into a strong spine. In some groups the cladodes are spiny tipped. *A. stipulaceus* and its relatives (apparently not in cult.) have the side branches developed into thorns.

Most of the ornamentals of the genus will not stand frost, but some of the Asiatic forms are perfectly hardy except in the North. Members of this genus furnish the most satisfactory "green" for decorative purposes known to the trade, some of the forms rivaling the finest ferns in their delicate beauty. Their ability to hold up for several days without wilting makes the cut sprays of some of the species necessary in some forms of decorative work.

403. Female flower of Asparagus officinalis, showing rudiment of stamen.

Nearly all the species are of easy culture and can be propagated readily by seed which is usually produced in abundance; also propagated by division and in some woody forms by cuttings.

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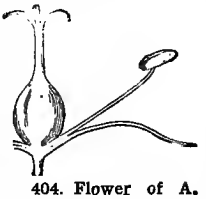
KEY TO THE SPECIES.

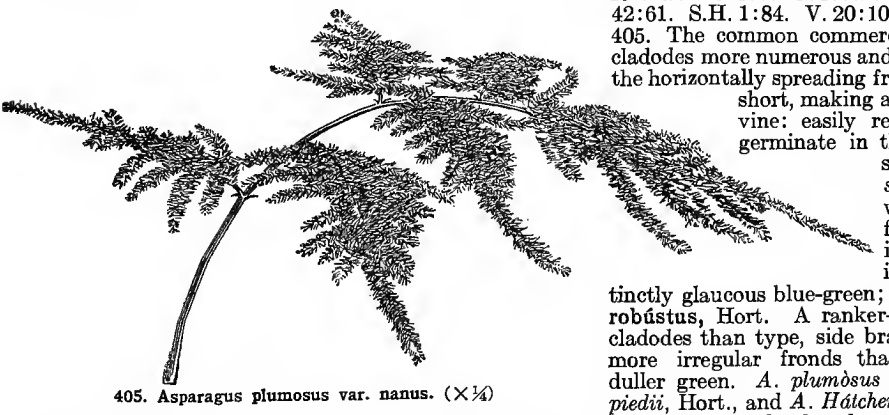
A. *Lf.-scales with a basal spur or scale: cladodes fascicled in axils of lf.-scales and, when flat, with stomata on both sides.*
B. *Fls. diœcious; fl.-buds axillary and present on young shoots, developing with the cladodes*.....Section **EUASPARAGUS**
C. *Cladodes filiform.*
D. *Plant an erect herb: cladodes terete*..... **1. officinalis**
DD. *Plant a semi-woody vine: cladodes angled*..... **2. verticillatus**
CC. *Cladodes flat, linear or linear-lanceolate.*
D. *Berry black: cladodes falcate, ¼–½in.: branches with twigs and cladodes in a horizontal plane: fls. opening widely: an erect herb* ..... **3. filicinus**
DD. *Berry white or pink: cladodes nearly straight, 1–2 in., not in a definite plane: a vine*..... **4. lucidus**
BB. *Fls. perfect, usually appearing after the cladodes or on special branches on the old wood.*
C. *Base of lf.-scale a spur, often a sharp spine: fls., when solitary, in axils with cladodes*..Section **ASPARAGOPSIS**
D. *Position of fls. axillary or terminal, with cladodes.*
E. *Cladodes filiform or 3-angled.*
F. *The fls. not umbelled, 4 or less.*
G. *Shape of cladodes 3-angled, in 3's: fls. axillary: an herbaceous vine, tuberous-rooted*..... **5. crispus**
GG. *Shape of cladodes terete, numerous: fls. terminal: woody vines, not tuberous-rooted: branches with twigs pinnate in a horizontal plane.*
H. *Lf.-scales white or whitish, spine deltoid: sts. slender, smooth*.. **6. plumosus**
HH. *Lf.-scales red-brown, spine terete, strong and sharp: sts. thick, with short pubescence.* **7. Cooperi**
FF. *The fls. in umbels.*
G. *Plant a slender green-stemmed vine: cladodes 3–8*..... **8. umbellatus**
GG. *Plant stiff gray-stemmed shrubby climber: cladodes 10–20* ..... **9. retrofractus**
EE. *Cladodes flat.*
F. *Berry 3-lobed: cladodes lanceolate: fls. terminal: erect shrub, 1 ft*.....**10. madagascar-[ensis**
FF. *Berry globose: cladodes linear-falcate: fls. axillary: a delicate vine*.....**11. scandens**
DD. *Position of fls. in racemes on old wood.*
E. *Cladodes 3- or 4-angled, flattened*.....**12. tetragonus**

EE. *Cladodes flat, linear or linear-lanceolate.*
F. *The cladodes arranged in horizontal plane on twigs: a long vine* ..... 13. **drepanophyllus**
FF. *The cladodes not in one plane.*
G. *Length of cladodes about 1 in.: st. 6 ft. or less: spines small* ..... 14. **Sprengeri**
GG. *Length of cladodes 2–3 in.: a rank-growing vine, 20–40 ft.* ..... 15. **falcatus**
CC. *Base of lf.-scale appressed, bract-like: stigma capitate: fls. solitary in axils without cladodes.*
Section **KODIASTIGMA**.. 16. **virgatus**
AA. *Lf.-scales not spurred: fls. axillary: cladodes solitary in axils, flat, lf.-like, stomata only on lower side.*
Section **MYRSIPHYLLUM**.. 17. **asparagoides**

1. **officinàlis,** Linn. ASPARAGUS. Figs. 402, 403. An erect herb from a woody crown with long fleshy roots: sts. smooth, much branched above, 4–12 ft. high: cladodes 3–8 in a fascicle, ¼–1 in. long, terete: lf.-scale with a short soft spur at base: fls. 1–4, in axils with cladodes or branches, campanulate, yellowish green: berries red, ¼–⅜in., 1–9-seeded; seed germinate in 12–14 days in warmhouse, often taking a month when planted outdoors in spring. Eu.—The esculent asparagus of the garden, the fruiting sprays with the bright red berries used for decorating. The young seedlings developed from a large number of seed planted in a small pot or pan make a very handsome table decoration. See *Asparagus, Esculent.*


404. Flower of A. plumosus. Typical of Asparagopsis.

2. **verticillàtus,** Linn. A semi-woody climbing vine from a woody rootstock: roots long-cylindric, fleshy: sts. stout (½in.), 10–15 ft. long, edible when young: branches green, angled, flexuose: cladodes 3–8, ¾–2 in. long, angled, filiform, not stiff: lf.-scales of main st. developed below into spines: fls. funnel-shaped in 1–4's in axils of lf.-scales: berries red, ¼in. diam., 1–3-seeded. Persia to Siberia. R.B. 20:154. G.W. 14:648. G.Z. 24:505.—A hardy ornamental climber; grows readily from seed, which germinates in about 3 weeks in a warmhouse; plants slow-growing at first.


405. Asparagus plumosus var. nanus. (×¼)

3. **filicìnus,** Ham. An erect herb with densely clustered fusiform tuberous roots 2–4 in. long: sts. erect, branching: branches with twigs and cladodes in a horizontal plane like *A. plumosus:* cladodes flat, lanceolate strongly falcate, 3–5, of varying lengths, ¼–⅝in.: fls. axillary on long slender pedicels, green; stamens and pistils white; perianth-lobes wide-spreading: berry black, ⅜in., 1–3-seeded. India and China. G.C. III. 44:122, 123.—Hardy herbaceous perennial, very ornamental, suggesting a delicate fern in appearance; several wild varieties.

4. **lùcidus,** Lindl. Semi-woody climber, 6–10 ft., few main branches: roots tuberous, 2–6 in. long: cladodes 3–5, flat curved linear about 1 in. long: lf.-scale on main st. with a short spine: fls. small, white, 1–4, in axils with cladodes: berries pink or white, ¼in. diam. China, Japan and Formosa. A.G. 13:78.—Probably hardy in most of U. S. Tubers edible.

5. **crìspus,** Lam. (*A. decúmbens,* Jacq., and Hort.). Roots tuberous, short, densely clustered about crown: sts. herbaceous, green, weak, climbing or drooping, 3–6 ft., much branched: branches deflexed, and zigzag: lf.-scale developed below into a weak spur: cladodes 3, 3-angled, reflexed, about ¼–⅜in. long: fls. on slender drooping pedicels, axillary, solitary, or in pairs, white, sweet-scented, resembling the fls. of *A. asparagoides*: berry white or pink, ½in., several-seeded, seeds small, black. S. Afr. A.F. 16:825.—Easily grown from seed or prop. by division; a beautiful plant for hanging-baskets. This species is often sold under the name of *A. scandens deflexus,* Baker, which has flat cladodes and 1–3-seeded, red berries.

6. **plumòsus,** Baker. ASPARAGUS FERN. Fig. 404. Woody, tall climbing vine: roots not tuberous, long, slightly fleshy: st. terete, green, glabrous: branches with twigs and cladodes arranged in a horizontal plane, making a compound pinnate frond, triangular in outline: cladodes numerous, 8–20 in a fascicle, ¼in. or less long, slender, terete, bright green: lf.-scale white or gray, on main st. developed below into a woody deltoid spine: fls. 1–4 at ends of twigs, white; perianth-lobes spreading obovate, blooming in autumn: berry 1–3-seeded, purple-black. S. Afr. F. 1882:101. F.R. 4:93. F.S. 2413–14. G. 25:110. G.C. II. 13:749; III. 23:146. G.Z. 25:2. A.F. 11:1178.—A popular decorative plant now almost superseded by some of its varieties. The cut sprays and strings of *A. plumosus* and its varieties are used in large quantities by florists on account of their beauty and keeping qualities. Most of the forms are prop. by seed or division but some are readily increased by means of cuttings. Var. **comorénsis,** Hort. (*A. comorénsis,* Hort.). Similar to *A. plumosus* but more robust: cladodes lighter green, more open and delicate in their arrangement: frond widely triangular, very regular. A.F. 18:684. F.E. 14: 462. F.R. 9:877. G.C. III. 23:181. Gng. 10:295. I.H. 42:61. S.H. 1:84. V. 20:101. Var. **nànus,** Hort. Fig. 405. The common commercial variety of the species: cladodes more numerous and shorter than type, making the horizontally spreading fronds more dense: sts. often short, making a short spray rather than a vine: easily reproduced by seed, which germinate in three weeks. Var. **tenuíssimus,** Hort. (*A. tenuíssimus,* Hort.). Fig. 406. A wiry stemmed variety with fewer cladodes longer than in type and not so much in a horizontal plane, distinctly glaucous blue-green; not a strong climber. Var. **robústus,** Hort. A ranker-growing vine with shorter cladodes than type, side branches making longer and more irregular fronds than *A. plumosus nanus,* a duller green. *A. plumòsus supérbus,* Hort., *A. Blámpiedii,* Hort., and *A. Hátcheri,* Hort. (F.E. 31:935), are all botanically closely related if not identical with *A. plumosus robustus* and with it are separated from the other forms of the species by their stronger growth and by the much less regular arrangement of the cladodes and twigs into a horizontal plane. Var. **compáctus,** Hort. A dwarf form, said to be a hybrid between *A. plumosus nanus* and *A. plumosus tenuissimus,* suitable for pot-plants. F.E. 16:637 See *Fern, Asparagus.*

7. **Coöperi,** Baker. Roots long, cylindric, more or less fleshy: sts. large, up to ¾in. diam. and 60 or more ft. long, branching above; main sts. and branches dark green, with a soft, very short pubescence: cladodes very dark green, ¼–½in. long, 5–12 in a cluster, much stouter than in *A. plumosus:* final branches with twigs and cladodes making beautiful pinnate fern-like sprays ½–3 ft. long: lf.-scale swollen at base, red-brown,

406. Asparagus plumosus var. tenuissimus. (×¼)

with a strong spine: fls. small, white, bell-shaped, sweet-scented: berry about ¼in. diam., red. S. Afr. G.Z. 21: 568, 569.—This species is probably the largest one in the genus, its long vines covered with beautiful dark green sprays making a very desirable cover for pillars. The side sprays are valuable for cut-green for florists' use and, when removed, a second crop will appear shortly on the old vines.

8. **umbellàtus,** Link. A spreading climber or undershrub: sts. terete, slender, scabrous, dark green, woody below, branching: branches and twigs often reflexed and pendulous: cladodes 3–10, terete, ¾–1 in. long, very dark green: fls. in axillary or terminal umbels; pedicels ½in. long, perianth largest of genus, ⅓–½in. spreading, white; segms. elliptic-obtuse; stamens dark yellow: berry globose, yellow to dark red. Canary Isls. and Madeira. B.M. 7733. G.C. III. 28:379.—The large, sweet-scented fls. produced abundantly in midsummer; a good plant for pillar decoration; grows well from seed.

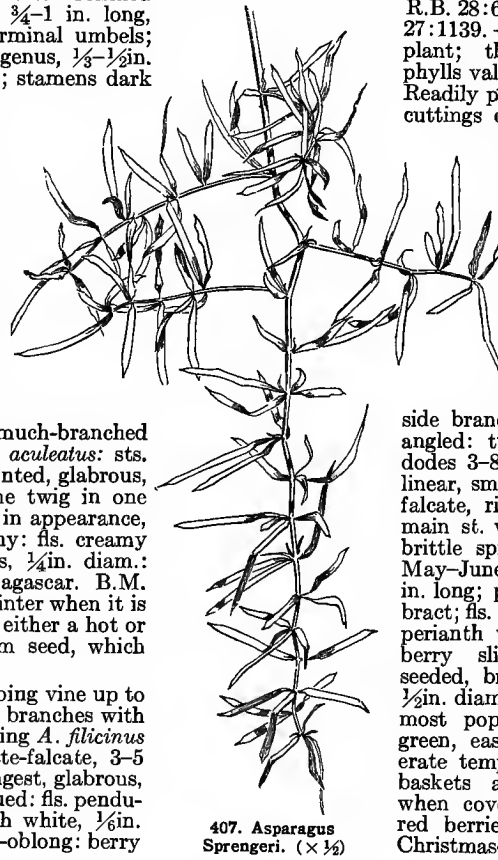
9. **retrofráctus,** Linn. (*A. retrofráctus arbòreus,* Hort.). Sts. slender (6 or more ft.), becoming woody and gray, scarcely climbing, zigzag, the branches wiry: cladodes in close clusters, green, filiform, about 1 in. long: lf.-scale bases spiny: fls. in umbels, small, white: berry small, nearly globose, 1-seeded. S. Afr. Gn. 59:111.

10. **madagascarénsis,** Baker. Erect, much-branched shrub, 1 ft. or more, suggesting *Ruscus aculeatus:* sts. green, angled: cladodes 3, lanceolate, pointed, glabrous, dark olive-green, often arranged on the twig in one plane making a pinnately compound lf. in appearance, ⅜–⅝in. long: base of lf.-scale not spiny: fls. creamy white, normally in 4's at end of twigs, ¼in. diam.: berry scarlet, 3-lobed, 1–3-seeded. Madagascar. B.M. 8046.—A good pot-plant, especially in winter when it is well set with scarlet berries. Thrives in either a hot or temperate greenhouse, easily prop. from seed, which are freely produced.

11. **scándens,** Thunb. A slender climbing vine up to 6 ft.: sts. green, branching freely above: branches with twigs and cladodes in one plane, suggesting *A. filicinus* somewhat: cladodes flat, long, lanceolate-falcate, 3–5 in.: fascicle ¼–½in. long, central one longest, glabrous, light green: lf.-scale minute, base not spined: fls. pendulous, solitary or paired in axils, greenish white, ⅛in. diam., perianth spreading, segms. elliptic-oblong: berry globose, ⅛in. diam., red, 1-seeded. S. Afr. B.M. 7675. G.C. III. 33:339.—One of the weaker-growing kinds of ornamental asparagus, thriving well in an intermediate house. A good decorative plant when grown in strings for table decoration; also good as a pot-plant. Var. **defléxus.** Similar to type but with branches deflexed: cladodes stiffer and smaller: fls. smaller: seed often white. G.W. 5:446; 13:301. *A. crispus* is often sold under this name, but is easily distinguished by its 3-angled cladodes (see discussion under No. 5).

12. **tetragònus,** Bresler (*A. racemòsus tetragònus,* Baker). A climbing vine, 15–20 ft. high: roots tuberous, elliptic, 1–2 in. long: sts. gray to brown, branching above: cladodes 3–8, usually 5, 3–4-angled, ⅓–⅝in. long, dense; more or less falcate: lf.-scale on main st. with a strong recurved basal spine up to ½in. long: fls. in racemes 2–3 in. long, on old wood; perianth white or pink, ¼in. diam., segms. obovate-obtuse; fls. fragrant. S. Afr. B.M. 8288. G.C. III. 23:147.

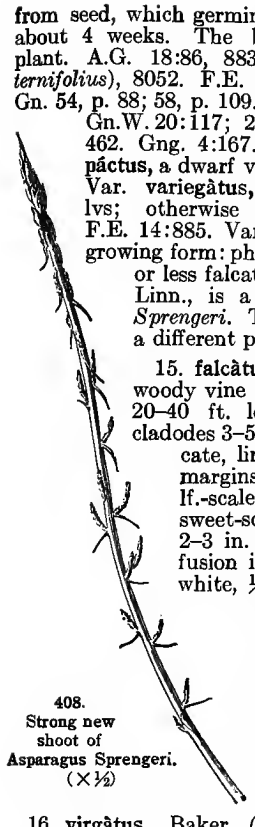
13. **drepanophýllus,** Welw. (*A. Duchésnei,* Linden). A tall climbing woody vine with tuberous roots 2–3 ft. long: sts. 20–30 ft. long, terete, without main branches: axillary twigs and cladodes making a compound cladophyll from upper axils: twigs ½–2 ft. long, thick-set with cladodes in fascicles of 3–5: lf.-scales on twigs 5-ranked but cladodes turned into a horizontal plane: central cladode 2–3 in. long, lateral 1½ in., the compound cladophyll suggesting a frond of Asplenium: lf.-base with a strong spine: fls. in dense erect racemes, 3–8 in. long; pedicels deflexed in fascicles of 3–8; perianth greenish, bell-shaped, not opening widely: berry rare, 3-lobed, usually 1-seeded, ⅛in. diam., bright scarlet, ripe in 90–120 days after the bloom. Oct.–Jan. S. Cent., Afr., Congo region. G.C. III. 28:305. R.B. 28:60. Gng. 15:131. A.F. 27:1139. —A highly decorative plant; the compound cladophylls valuable in florists' work. Readily prop. by division or by cuttings of the twigs taken off with a heel, or piece of the main st. attached and put in a sandy soil in a close case with bottom heat.



407. Asparagus Sprengeri. (×½)

14. **Spréngeri,** Regel. Figs. 407, 408. Roots tuberous, white, elliptic, not densely clustered: sts. numerous, scarcely climbing, 6 ft. or less: side branches numerous, small, angled: twigs 1–3 in. long: cladodes 3–8, ½–1½ in. long, flat, linear, smooth, pointed, slightly falcate, rich green: lf.-scale on main st. with a slender brown brittle spine ⅜in. long: fls. in May–June, in open racemes 1–3 in. long; pedicels 1–2 from each bract; fls. whitish pink, fragrant, perianth wide-spreading, ⅛in.: berry slightly 3-lobed, 1–3-seeded, bright coral-red, up to ½in. diam. Natal.—One of the most popular plants for cut-green, easily grown in a moderate temp. Plants in tubs or baskets are very ornamental when covered with the bright red berries which ripen about Christmas-time. Easily grown

from seed, which germinates in a temperate house in about 4 weeks. The best asparagus for a house plant. A.G. 18:86, 883; 19:101. B.M. 7728 (as *A. ternifolius*), 8052. F.E. 9:11. F.R. 4:95. G. 21:123. Gn. 54, p. 88; 58, p. 109. G.L. 17:175. Mn. 8, p. 151. Gn.W. 20:117; 23:607. G.W. 4, p. 109; 13, p. 462. Gng. 4:167. G.C. III. 37:10. Var. **compáctus,** a dwarf variety seldom over 18 in. long. Var. **variegátus,** a form having variegated lvs; otherwise like the type. Gn. 59:145. F.E. 14:885. Var. **falcatoïdes,** a large strong-growing form: phylloclades solitary to 5–6 more or less falcate. *A. sarmentòsus,* Hort., not Linn., is a short compact form of *A. Sprengeri.* The true *A. sarmentosus* is quite a different plant and not in cult.



408. Strong new shoot of Asparagus Sprengeri. (×½)

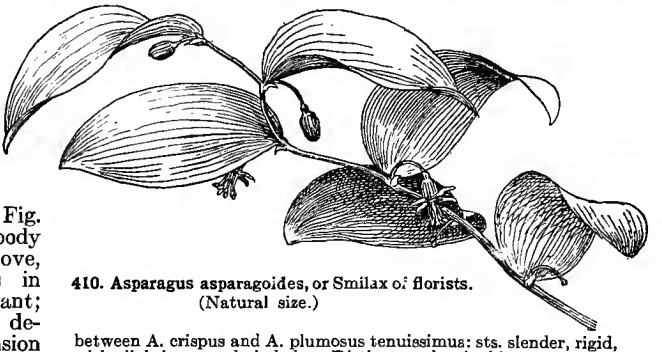
15. **falcátus,** Linn. A large spreading woody vine with stout gray or brown sts. 20–40 ft. long, much branched above: cladodes 3–5, or more at ends of twigs, falcate, linear-lanceolate, with undulate margins, rich dark green, 2–3 in. long: lf.-scales with stout basal spines: sweet-scented fls. in loose racemes 2–3 in. long, produced in great profusion in midsummer; perianth pure white, ¼in. diam., segms. lanceolate; stamens yellow: fr. dull brown. Trop. Asia and Afr.—One of the largest and finest species of the genus; thrives under temperate conditions, growing outdoors in the absence of frost. G.C. III. 23:123; 41:82. Ref. Bot. 261. G.W. 5:334.

16. **virgátus,** Baker (*A. elongàtus,* Hort.). Fig. 409. Roots fibrous, crown with long semi-woody rhizomes: sts. erect (3–6 ft.), much branched above, branches long, straight or drooping: cladodes in 3's, stiff, ¼–¾in. long, angled, not very abundant; cladodes and sts. dark green: lf.-scale white, developed basally into an appressed bract-like extension similar to upper part: fls. solitary at nodes on drooping pedicels, no cladodes in axils with fls.; perianth greenish white, wide-spreading, ⅛in. diam.; stigma capitate: berry 1–2-seeded, dull orange-red, ⅛in. in diam. S. Afr. F.E. 27:114.—Easily grown from seed, which germinates in 3 weeks, or from cuttings of rhizomes. Not highly ornamental, but of value in decorative work on account of its erect habit.

409. Flower of Asparagus virgatus. Typical of Kodiastigma.

17. **asparagoïdes,** Wight (*Myrsiphýllum asparagoïdes,* Willd. *A. medeoloïdes,* Thunb.). Smilax of florists. Fig. 410. Tall slender glabrous twiner: sts. slender, much branched: cladodes single in axils of lf.-scales, ovate, about 1 in. long, usually spreading horizontally: lf.-scale small, not developed into a spur at base: fls. solitary or paired in axils on slender pedicels, greenish white; perianth-lobes spreading or recurved from beyond middle: berries dark purple, 1–3-seeded. S. Afr. B.M. 5584. R.H. 1895: 177. S.H. 1:417; 2:160. Gn. 42, p. 536. G.W. 1, p. 206.—Much grown for florists' use in decorations. Seed small, germinating in about 3 weeks (see cultural notes under *Smilax* in a succeeding volume). Var. **myrtifòlius,** Hort. "Baby" Smilax, an extremely light and elegant variety with much smaller lvs. than the type, becoming popular.

A. acutifòlius, Linn. Semi-hardy, becoming a woody shrub in the S., zigzag, branching, 5 ft.: cladodes short, stiff, terete, spiny-tipped in fascicles of 5–12, ½in. long: fls. dicœcious, yellow: berry waxy olive-green.—A dark green cedar-like ornamental. Medit. region.—*A. æthiòpicus,* Linn. Tropical vine: cladodes 3–5 ft., linear falcate, 1–2 in. long: lf.-base spiny: fls. in racemes, near A. Sprengeri. S. Afr.—*A. africànus,* Lam. Woody semi-climber, spiny: cladodes filiform-terete, stiff, dark green, up to 20 in a cluster 1 in. long: fls. in umbels. S. Afr.—*A. àlbus,* Linn. (A. Pastorianus, Webb & Berth.). A white-stemmed branching woody shrub, semi-hardy, 3–4 ft. high: cladodes densely fascicled, 1 in. long: lf.-scale with a long sharp spine: fls. in umbels. Medit. region.—Very susceptible to attacks of red-spider. G.Z. 1907:31.—*A. asiáticus,* Linn. A tall branching woody vine: cladodes numerous in clusters, soft-filiform, ½in. long: fls. in umbels. S. Afr.—*A. declinàtus,* Linn. Allied to A. plumosus but with cladodes about ½in. long: branches slender, drooping: fls. axillary, small, white: berries 1-seeded. S. Afr.—*A. laricínus,* Burch. A woody shrub suggesting A. retrofractus but with cladodes 1 in. long. S. Afr. G.C. III. 23:122.—*A. lóngipes,* Baker. A copiously branched undershrub with subterete slender green cladodes ½–1 in. long in whorls of 9–12: fls. axillary, solitary or paired. S. Cent. Afr.—*A. myriocládus,* Hort. (A. Greenfieldii, Hort.). An erect, much-branched shrub, 6 ft., with tuberous roots: st. gray: branches zigzag with dense clusters of light green filiform cladodes ¾in. long, becoming dark green with age.—Very ornamental: fls. unknown, but it is closely related in type to A. retrofractus. Natal. G. 25:293; 33:435. Gng. 12:547. F.E. 16:637. The true A. myriocladus, Baker, is related to A. Sprengeri and has flat cladodes and racemose fls. This species is apparently not in cultivation.—*A. oligoclònus,* Maxim. Erect, hardy herbaceous perennial suggesting A. officinalis: cladodes more dense, slender and graceful: 1–2 ft.: fls. dicœcious, campanulate. N. Asia.—*A. schoberioïdes,* Kunth. Erect, hardy herbaceous perennial, 1–3 ft.: roots tuberous: cladodes long, 3-angled, flat, ascending: fls. nearly sessile, dicœcious: berries red. Japan and China.—*A. Sieberiànus,* Hort. A supposed hybrid between A. crispus and A. plumosus tenuissimus: sts. slender, rigid, with slightly curved cladodes. Distinct and valuable as a market plant.—*A. tenuifòlius,* Lam. Herbaceous perennial: like A. officinalis, with very slender, numerous cladodes and large bright red berries. S. Eu.—*A. trichophýllus,* Bunge. Hardy herbaceous perennial, somewhat twining, 3–6 ft.: cladodes like A. officinalis, ¼–1 in. long: fls. dicœcious (long-campanulate) on drooping pedicels. N. Asia.



410. Asparagus asparagoïdes, or Smilax of florists. (Natural size.)

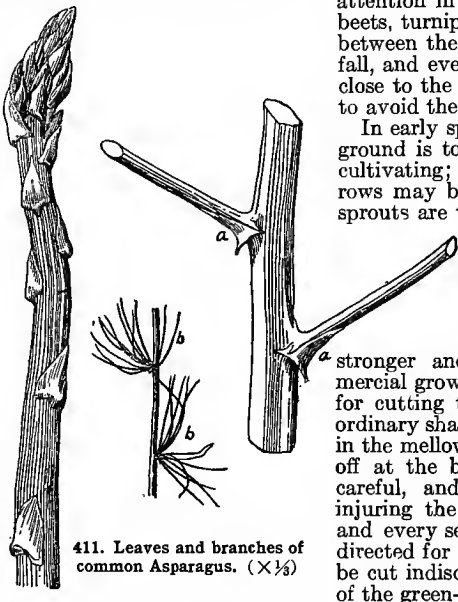
J. B. Norton.

ASPÁRAGUS, ESCULENT (*Aspáragus officinàlis,* Linn.). *Liliàceæ.* A perennial herb, cult. for the succulent young shoots that arise from the crown in spring.

Asparagus is native to Europe. It has been cultivated 2,000 years and more. It was known to the Greeks and Romans. The so-called lvs. of asparagus are really leaf-like branches. The lvs. are the scales, which are well shown on the shoot at the left in Fig. 411. From the axils of these scales, branches may arise, *a a.* At *b b* are shown clusters of branchlets, or "leaves," issuing from the axils of scales or lvs.

Being a rugged plant, asparagus will live and in a measure thrive on almost any kind of soil, even under adverse circumstances and when entirely neglected. Occasionally one may find apparently thrifty plants in fence rows, or strong stalks pushing up through stone heaps or other rubbish piled foot-thick upon an old abandoned asparagus bed. Plants on good soil will get so large, and the immense network of roots so well anchored in the soil, that all the strength of a good team may be insufficient to pull them out, and sometimes several years' persistent efforts may be required to clear them out of a piece of ground once used as an asparagus patch. The stalks that the discriminating growers and fastidious consumers want are those an

inch in diameter and deliciously tender and succulent, and these can be grown only on good plants set far enough apart on well-drained, well-manured and well-tilled soil. To secure the choice early stalks that bring the high prices, the land selected for an asparagus patch should be a warm rich loam, preferably exposed to east or south. Manures and fertilizers, also, must be used most lavishly. In this respect, many growers fail to obtain best results, such as are within their reach by greater liberality. Unless the soil is already well supplied with vegetable matter and for that reason very loose and mellow, bulky manures, such as fairly well-rotted stable manure or rich compost, are almost or quite indispensable at the start. A heavy dressing is to be plowed under, and should be well and deeply mixed with the soil by replowing and reworking the land. Afterwards concentrated manures, rich especially in nitrogen and potash, will do very well for loose soils, and may be used broadcast on top, as the crop appears to need them from year to year, at least for a while. Even then an occasional, or better, yearly, application of good stable manure or compost placed in furrows plowed (with a one-horse plow) on each side of the rows after the cutting season or in early fall, will be of benefit or become necessary to keep the yield up to a high mark. To start a plantation in the right way, the selection of good strong one-year-old plants is of much importance. They are usually preferable to the ordinary two-year plants. To grow one's own supply for starting a plantation a year later is usually a safer plan than to depend on purchased plants. The male, or pollen-bearing, plants are often more vigorous and more productive of good stalks than the female or seed-bearing plants; but one cannot very well tell the one from the other unless they bloom, until long after they are already established in the plantation, when it would be impracticable to tear out the less desirable female plants and replace them with the male plants.—The seed, obtainable from any regular seed house, is rather hard-shelled and sometimes slow to germinate. It is important to give the seedling plants the longest possible period of growth so as to secure the strongest possible plants. It is advisable, therefore, to soak the seed, or give it special treatment or seed stimulation, before sowing it, and to sow it just as soon in spring as a rich mellow seed-bed can be prepared. The rows or drills may be made a foot apart, and seed sown rather thinly. Plants are to be thinned to 3 inches apart at an early age, and weeds should be carefully kept down from the very start. In short, nothing should be neglected to prevent any interference with the rapid and healthy growth of the seedlings, for the future outcome hinges, to a great measure, on a favorable early start.—When getting ready to set the plants, and after the land has been carefully and deeply plowed and harrowed, plow out furrows 4 or even 6 feet apart. It may look like a sinful waste of good land to set asparagus so far apart, but even at 6 feet the roots will fill the soil and reach across



411. Leaves and branches of common Asparagus. (×⅓)

the rows, and the fat stalks obtainable by wide planting are worth more in our markets than the inferior ones usually found there. Some markets demand or prefer green stalks which are mainly grown above ground. In that case, make the furrows 5 to 9 inches deep. In other markets blanched shoots are wanted, and these are of superior flavor and tenderness, provided they are grown in mellow soil and under high and skillful culture. In that case, make the furrows a few inches deeper than for plants set for green stalks. Set the plants in the furrows about 2 feet apart, each on a little mound of soil, spreading the roots in the same way as they grew in the seed-bed. Cover with mellow soil to the depth of a few inches, and afterwards, in the course of some weeks and by means of some suitable tools (cultivators, harrows, and the like), gradually fill the furrows even with the ground-level. A still better plan when the material can be had, especially for the home-gardener, is to fill the furrows with fine old compost, wood's earth, leaf-mold, or any other loose and rich material, as the covering above the crowns of the plants cannot be made too loose. It is advisable and will insure closer attention in cultivation, to grow some hoed crop, like beets, turnips, radishes, cabbage, beets, beans or peas, between the rows of asparagus the first year. In the fall, and every fall thereafter, cut the asparagus stalks close to the ground and remove them from the patch, to avoid the scattering of the seed.

In early spring of the second year, the surface of the ground is to be loosened by shallow plowing or deep cultivating; and when the first sprouts appear, the rows may be hilled up to some extent if any of the sprouts are to be cut for use. Under especially favorable conditions a few may be cut the second year. It is better for the plantation and its future value, however, if no cutting is done that year. Plants left intact until the third year, and kept in a high state of cultivation, will grow much stronger and be more productive afterward. Commercial growers use specially devised asparagus knives for cutting the stalks. In the absence of such, any ordinary sharp table or kitchen knife may be used, or in the mellow soil the blanched shoots may be broken off at the base with the finger. In cutting, be very careful, and try to avoid cutting later shoots or injuring the crown of the plants. The third season and every season thereafter, loosen up the ground as directed for the second season. The shoots are now to be cut indiscriminately and clean, up to the beginning of the green-pea season. After that, allow them to grow undisturbed, but continue cultivation, to keep the ground-surface mellow and free from weeds. For market, wash the freshly-cut stalks and tie them in neat, compact bunches of the size demanded in the particular market, using some bright-colored ribbon, or perhaps rubber bands. If to be shipped, especially for longer distances, pack the bunches in moist moss or other material that will keep the stalks fresh.

The varietal differences in the asparagus plant do not appear to be very pronounced except in the color of the young shoots, and most of the variations seem to be due to differences in culture and environment rather than to those characteristic of the variety. American seedsmen offer the following as distinct varieties: Colossal (Conover's), Palmetto, Mammoth (Barr's), Columbian (Mammoth Columbian White), Argenteuil (Giant Argenteuil), Bonvallet Giant, Reading Giant.

To save the seed, strip the ripe berries off the stalks by hand, or thresh them off with a flail, put them in a sound barrel or tank, and mash them with a wooden pounder, to separate the hard, black seeds from the pulp. Clean them by washing in plenty of water, pouring off the pulp and skins; then dry and store.

To any person who has even a little land to use for a home-garden, no better advice could be given than to

plant in a corner or at one side of it 50 or 100 asparagus roots for his family, as no other use of that spot, ordinarily, may be expected to give more real benefit, enjoyment and value. The number of roots named will under average conditions give all the stalks that a large family could use, and several times the quantity that a person of ordinary means would feel able to purchase for the family table in the open market. For the market-gardener, especially one with a regular retail trade, few if any vegetables offer equal chances of profit and regular returns and a sure income at a most opportune time (spring).

Enemies.—The asparagus rust (*Puccinia asparagi*) has often done considerable damage. Planting rust-resistant varieties is the best procedure. Argenteuil and Reading Giant afford the best relief. Dusting completely with flowers of sulfur when the dew is on, and after the cutting season, is the best remedy; two applications, three or four weeks intervening, are usually sufficient.

Of insect enemies, two have become well known on asparagus plants in America, namely, the common asparagus beetle (*Crioceris asparagi*) and the twelve-spotted asparagus beetle (*C. 12-punctata*). The following remedies are recommended: chickens and ducks; close cutting of the young shoots in the early season, and the use of arsenate of lead or of dry arsenites dusted on the dew-wet plants after the cutting period.

The subject of asparagus and asparagus-growing is treated in the following books and bulletins: Asparagus, by F. M. Hexamer, Orange Judd Company. Farmers' Bulletin No. 61 (Asparagus Culture), issued by the Department of Agriculture, Washington, D. C. Bulletin No. 151 of the Maryland Station (Fertilizers for Asparagus). Bulletin No. 34 of the Missouri Station (Asparagus and Rhubarb Culture). Bulletins Nos. 165 and 172 of the California Station (Asparagus and Asparagus Rust in California). T. GREINER.

ASPÀSIA (Greek personal name). *Orchidàceæ.* Epiphytic hothouse orchids.

Stems thickened into pseudobulbs, 1- or 2-lvd.: racemes lateral; sepals and petals nearly alike, spreading; lip with the claw adnate to the column, the blade spreading; lateral lobes distinct or confluent with the middle lobe; pollinia 2.—Species about 8, ranging from Cent. Amer. to Brazil.

epidendroìdes, Lindl. Pseudobulbs, oblong, 2-edged: lvs. linear-lanceolate: racemes of 2–4 fls.; sepals and petals whitish yellow, streaked with brown; lip white, dotted with purple. Panama. B.M. 3962.

lunàta, Lindl. Pseudobulbs, 2-edged, oblong: lvs. oblong-ligulate, up to 6 in. long: fls. single, or rarely 2; sepals and petals linear-lanceolate, acuminate, green or yellowish, marked with violet-purple; lip white, marked with purple. S. Brazil.

variegàta, Lindl. Pseudobulbs ovate or oblong, 2-edged: lvs. lanceolate-ligulate, up to 8 in. long: raceme of 2 or 3 fls.; sepals oblong-lanceolate, acute, greenish or yellowish, marked with interrupted longitudinal black-purple lines; petals obovate-oblong, acute, yellowish veined with purple; lip white, yellowish at the base, spotted with purple. S. Amer. B.M. 3679. B.R. 1907.

GEORGE V. NASH.

ASPEN: *Populus.*

ASPERÉLLA: *Hystrix.*

ASPÉRULA (*roughish;* referring to lvs.). *Rubiàceæ.* WOODRUFF. Mostly dwarf hardy herbs, for borders, rock gardens and shady places.

Annual or perennial: sts. square: lvs. whorled (some of the lvs. are really stipules): fls. many, small, mostly 4-parted, produced freely from May to July; corolla funnelform, which distinguishes it from the closely related Galium in which the corolla is rotate.—About 80 species in Eu., Asia and Austral.

The commonest species is *A. odorata,* the Waldmeister of the Germans, which is used in their Maitrank, or May wine, and in summer drinks. The dried leaves have a hay-like fragrance, lasting for years, and are often kept with clothes. The plant occasionally escapes from gardens. *A. hexaphylla,* with its delicate, misty spray, is used with sweet peas and other cut-flowers that are inclined to look lumpy. Other plants for this purpose are *Gypsophila paniculata, Statice latifolia,* and several galiums, all of which have small, abundant flowers in loose panicles on long, slender stems.

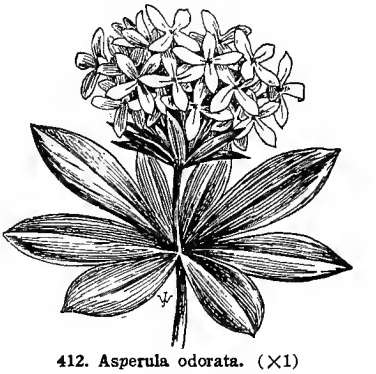
In half-shaded and moist soil, asperulas grow very luxuriantly until late fall. In dry and sunny places they soon become stunted, and die down before the season is over.

Propagation is by division and by seeds.

A. *Plants perennial: fls. white or pink.*

B. *Corollas 4-lobed.*

odoràta, Linn. SWEET WOODRUFF. Fig. 412. Habit erect or ascending: height 6–8 in.: lvs. usually in whorls of 8, lanceolate, finely toothed or roughish at the margin: corollas campanulate: seeds rough. Eu. and Orient. Eng. Bot. 2:775. Baxter Brit. Bot. 1:46.—Increases rapidly, and is used for carpeting shady places, and for edgings.



412. Asperula odorata. (×1)

Gussònei, Boiss. (*A. suberòsa,* Guss.). A glaucous, smooth, usually cespitose perennial suitable only for the rock-garden: lvs. small, in pairs, some ovate-oblong, the rest lanceolate-linear: fls. at the ends of the branches, the corolla smooth and pinkish, not showy. Sicily.—A graceful little alpine.

hexaphýlla, All. Plant-st. glabrous: habit ascending, slender: height 1–2 ft.: lvs. in whorls of 6, linear, acute, rough: corollas tubular-funnel-shaped: panicles very loose; fls. larger than the bracts: seeds smooth. Italy, Hungary, Pyrenees on high passes and dry mountain-sides.—Well-grown specimens may be 3 ft. in diam. and nearly as high.

hírta, Ramond. A many-stemmed hairy perennial, suitable for the alpine garden: sts. 4-sided, with verticillate lvs. in 6's: lvs. linear, 1-nerved: fls. small, pinkish. Rocky situations in the Pyrenees. July, Aug.

BB. *Corollas often 3-lobed.*

tinctòria, Linn. DYER'S WOODRUFF. Habit procumbent unless supported: height 1–2 ft., the st. purplish: lvs. linear; lower ones in 6's, middle ones in 4's, uppermost ones in 2's: bracts ovate: fls. reddish on outside: roots large, creeping widely, reddish. Dry hills and rocks of Eu.

AA. *Plants annual: fls. blue.*

orientàlis, Boiss. & Hohen. (*A. azùrea* and *A. setòsa,* Jaub. & Spach. *A. azùrea-setòsa* and *A. setòsa-azùrea,* Hort.). Height 1 ft.: lvs. in whorls of 8, lanceolate, bristly: fls. longer than the bracts. Eu. and Orient.

A. cynánchina, Linn. 9–12 in., glabrous: fls. corymbose on erect peduncles: lvs. 4 to a whorl. Eu. and Asia.—*A. longiflòra,* Waldst. 6–8 in., weak, glabrous: fls. white, yellowish inside: lvs. 4 to a whorl, linear-lanceolate. Eu.—*A. taurina,* Linn. 1 ft., erect, smooth: fls. in fasciculately umbelled corymbs, white: lvs. 3-nerved, ciliate, 4 to a whorl. Perhaps not hardy N. S. Eu.

WILHELM MILLER. N. TAYLOR.†

ASPHODEL: *Asphodeline* and *Asphodelus.*

ASPHODELÌNE (name modified from *Asphodelus*). *Liliàceæ*. Hardy herbaceous plants, distinguished from Asphodelus by the erect and leafy stems.

Asphodelines have long racemes of yellow or white fls. in June and July. All the older species were described under Asphodelus. In 1830, Reichenbach made the new genus Asphodeline for *A. lutea* and others. The only species advertised in Amer. is *A. lutea*, but all those described below are likely to be in cult. Monogr. by J. G. Baker in Journ. Linn. Soc. 15:273–278 (1877). There are some 145 species in the Medit. region and the Caucasus.

The culture of *Asphodeline lutea* is simple. Any soil will suit. Partial shade is allowable, but flowers are often better in the sun. Propagated readily by division, in spring or the fall.

A. *Sts. leafy up to the raceme.*

B. *Fls. yellow.*

lûtea, Reichb. (*Asphódelus lùteus*, Linn.). TRUE ASPHODEL of the ancients, or KING'S SPEAR. Height 2–4 ft.: roots thick, fleshy, stoloniferous: lvs. 3–12 in. long; margins rough: racemes 6–18 in. long, 3 in. wide: bracts large, membranaceous, persistent. Italy, Muritania and Algeria to Tauria and Arabia. B.M. 773. L.B.C. 12:1102 as *A. tauricus*.—The best species. A double-fld. var. *flòre-plèno* has been advertised.

BB. *Fls. white.*

taûrica, Kunth. Height 1–2 ft.: roots slender: lvs. 3–9 in. long; margins membranaceous: racemes 6–12 in. long, 1½–2 in. wide: bracts 9–12 lines long, 1½–2 in. wide. Caucasus, Tauria, Syria, Asia Minor, Greece. G.C. III. 21:175.

AA. *Sts. leafy only a third or half the way to the raceme.*

B. *Fls. white: raceme dense.*

globífera, J. Gay. Height 2–3 ft.: lvs. numerous, subulate 5–6 in. long, 1–1½ lines broad: racemes dense-fld.: caps. globose. Cappadocia.

BB. *Fls. yellow: raceme lax.*

C. *Bracts large, 6–12 lines long, long-cuspidate.*

tenûior, Ledeb. Height 1 ft.: smaller than *A. lutea*, with finer lvs. and smaller, fewer and paler fls. Caucasus, Armenia, N. Persia. B.M. 2626.—Especially distinguished by the stalk being naked at the upper part, below the raceme of fls., and the bracts as short as or shorter than the peduncle.

CC. *Bracts small, 1½–3 lines long, short-cuspidate.*

libúrnica, Reichb. (*A. crética*, Vis., not Boiss.). Height 1–2 ft.: lvs. 3–4 in. long: racemes weak, 6–9 in. long, when expanded 2½–3 in. wide; stamens unequal. Greece, Crete, Dalmatia, Austria, Italy, not Asia Minor. L.B.C. 10:915 (as *A. cretica*).

brevicaûlis, J. Gay (*A. crética*, Boiss., not Vis.). St. often flexuose, that of all the others here described being erect and strict. Asia Minor, Syria, Palestine, Egypt.

AAA. *Sts. leafy only at the base: fls. white: racemes dense.*

B. *Racemes usually simple.*

C. *Height 8 ft.: sts. having lf.-scales.*

imperiàlis, Siehe. Tallest species of the genus: fls. large, reddish white: lvs. numerous, forming a large rosette, and also clothing part of the st. Cappadocia. G.C. III. 22:397.

CC. *Height 1½–3 ft.: sts. not having lf.-scales.*

damascèna, Baker. Height 1½–2 ft.: bracts membranaceous, lanceolate, the lowest 9–12 lines long: racemes simple, rarely branched. Mt. Lebanon.

Balansæ, J. Gay. Height 2 ft.: bracts scarious, 6–9 lines long. Cilicia. Gt. 46, p. 521. G.C. III. 23:111.

BB. *Racemes much panicled.*

isthmocárpa, J. Gay. Height 2 ft. Cilicia. G.C. III. 23:117.

WILHELM MILLER. N. TAYLOR.†

ASPHÓDELUS (Greek name of unknown origin). *Liliàceæ*. ASPHODEL. Hardy herbaceous stemless plants, with white, lily-like fls. in long racemes, fleshy fascicled roots, and firm, linear, radical, tufted lvs.: perianth funnel-shaped; segms. 6, oblong-ligulate, obtuse, equal, with a distinct nerve on the back, and always ascending.—Probably a half-dozen species in Medit. region and India.

The asphodel of the ancients, or king's spear, is *Asphodeline lutea*, which see. Homer mentions the asphodel meadows of the dead, where the shades of heroes congregated in Hades. The asphodel in Greek mythology was the peculiar flower of the dead. It has always been a common weed in Greece, and its pallid yellow flowers are associated with desert places and tombs. The word daffodil is a corruption of asphodel. The asphodel of the early English and French poets is *Narcissus Pseudo-Narcissus*. J. G. Baker, in his revision of the genus in Jour. Linn. Soc. 15:268–272 (1877), refers forty species of other botanists to *A. ramosus*, the dominant type, of which he makes three subspecies. These subspecies are here kept distinct, for horticultural purposes, as good species. They are the ones first described below. *A. ramosus* and *A. albus* are among the few current trade names in America.

Culture simple; see *Asphodeline*.

A. *Plant perennial: lvs. 3-angled.*

B. *Scape long.*

C. *Racemes simple or sparingly branched.*

álbus, Mill., not Willd. BRANCHING ASPHODEL. Bracts buff-colored when young: filaments deltoid at the base: caps. medium-sized, 5–6 lines long, subglobular or ellipsoid. S. Eu.

cerasíferus, J. Gay. Bracts pale yellow: filaments wedge-shaped at the base, but rapidly becoming awl-shaped: caps. large, 8–10 lines thick, flattish globular, umbilicate. W. Medit. region.

CC. *Racemes much branched or panicled.*

comòsus, Ford. Radical lvs. sword-shaped, 1–1½ ft. long, acutish, sharply keeled on the back: panicle branched, the terminal racemose cluster 2–3 in. diam.; petals white, ⅝–¾ in. long. Himalayan region.

tenuifòlius, Cav. (*A. microcárpus*, and *A. æstìvus*, Reichb.). Bracts pale yellow at first: filaments 4-angled at the base: caps. small, 3–4 lines long; obovoid-globose. Medit., Canary Isls.

BB. *Scape short, almost wanting.*

acaûlis, Desf. Lvs. 6–20, in a dense rosette, 3–4 in. long, minutely pubescent: fls. 6–20, in a crowded corymb; segms. of perianth 2–3 lines wide. Algiers. B.M. 7004.

AA. *Plant annual: lvs. cylindrical, hollow.*

fistulòsus, Linn. Height 16–20 in.: lvs. 12–30, in a dense rosette, 6–12 in. long, striate, awl-like, glabrous: segms. of perianth 1–2 lines wide, lined with pink: buds pink: fls. pinkish. France and Portugal to Syria, Arabia and Afghanistan. B.M. 984. L.B.C. 12:1124.—Needs protection under glass in winter. If removed early in autumn to a greenhouse, it may be induced to seed freely.

A. créticus=Asphodeline liburnica.—*A. lùteus*=Asphodeline lutea.—*A. Villársii*, Verl., is a form of A. ramosus, from E. France, with long, dense racemes and dark brown bracts.

WILHELM MILLER. N. TAYLOR.†

XII. Asparagus, variety Colossal.

ASPIDÍSTRA (Greek, *a small, round shield;* referring, probably, to the shape of the stigma). *Liliàceæ.* A popular florists' plant, grown for its stiff, shining, beautiful foliage, which is sometimes striped.

Leaves all radical, many, long, gradually narrowed into petiole, the rhizome thick and sometimes creeping: fls. inconspicuous and borne close to the ground; perianth wide-campanulate, 8-lobed; stamens 8, attached on the tube, the filaments very short; ovary 4-celled: fr. a globose indehiscent 1-seeded berry.—Three or 4 species in Himalaya, China and Japan. The casual observer never suspects that Aspidistra is a liliaceous plant. The parts of the fl. in monocotyledons are typically in 3's. The genus Aspidistra is considered abnormal, as usually having its parts in 4's. This tetramerous state (which is here considered the normal one, and described below) is pictured in B.M. 2499, but the species was first described upon a trimerous state, and pictured in B.R. 628. In *A. lurida*, the trimerous state must be regarded as an exceptional reversion: in *A. typica*, B.M. 7484, the trimerous state is thought to be constant.

Aspidistra is invaluable to the florist in decorative work, owing to its ability to withstand rough usage, dust, heat, cold and drought. The foliage is very useful when cut for mixing with amaryllises when they are used as cut-flowers, lasting for weeks in good condition; for such purposes the aspidistra may be planted under greenhouse benches in waste places for the production of leaves alone. The variegated variety is often seen, but a poor soil must be used or the variegation will speedily disappear. To increase the plants, divide in early spring when repotting, shaking out the old soil from the roots and separating the leaves, putting several in a pot of a useful size, a 6-inch being large enough to hold a number of leaves and their roots. (E. O. Orpet.)

lùrida, Ker-Gawl (*A. elàtior*, Hort. *A. punctàta*, Lindl.). Fig. 413. Lvs. 15–20 in. long, stiff, evergreen, oblong-lanceolate, sharp-pointed, radical; blade narrowed into a channeled petiole a third of its length: fls. lurid purple, on short 1-fld. scapes; perianth segms. 8; stamens 8; stigma broadly shield-shaped, like a small mushroom. China. B.R. 977. Var. **variegâta,** Hort., has alternation of green and white stripes, no 2 lvs. being exactly alike.—In Fla., the aspidistra makes beautiful dense specimens in unheated plant-sheds. It thrives in sunshine when growing along the edges of ditches and flowing water.

A. typica, Baill. Rootstock creeping: lvs. elliptic-lanceolate, long-petioled, about 7-nerved: fls. greenish or whitish, speckled with red, purple inside, trimerous. China. L. H. B.†

ASPÍDIUM: *Dryopteris* and *Polystichum.*

ASPLENÉNDRIUM: *Thamnopteris.*

ASPLÈNIUM (Greek, *not the spleen;* referring to supposed medicinal properties). *Polypodiàceæ.* A large, widely distributed genus of ferns, containing some 200 species. Some of them hardy, and many others grown in the greenhouse.

Aspleniums are distinguished by the free veins, and by the elongated sori covered by an indusium, which normally is attached to one side of a vein. The species here included under Asplenium, which have some of the sori curved across the subtending veinlets and certain differences in the internal structure of the st. are placed by many botanists in a separate genus, Athyrium; in the list below, Nos. 10, 25, 26, and 27 belong in this group.

Aspleniums enjoy an abundance of moisture at the roots, but they will turn brown in the winter months in an excessively moist atmosphere. They should be kept in a very lightly shaded position. A good potting material consists of equal parts of rich soil and leaf-mold or peat. The following are some of the most useful commercial kinds: *A. Belangeri*, height 2½ feet; *A. bulbiferum* (including *A. laxum*), which grows quickly into a handsome specimen about 20 inches high, and seems to stand the hot, dry American summers better than other species; *A. salicifolium;* and *A. viviparum*, which is dwarf, compact, with lace-like fronds, and easily propagated. For hanging-baskets, *A. flaccidum* is best. The foregoing species and others of like habit develop small plantlets on the surface and edge of pinnæ. As soon as these are sufficiently strong, they may be detached, with a small piece of old pinnæ, and pricked into shallow pans, the older part being placed below ground to hold the young plant firmly in position until roots have

413. Aspidistra lurida var. variegata.

formed. The best soil for this purpose is composed of equal parts of fresh garden soil, leaf-mold or fine peat, and sand. Plant very firmly, and place in a shady, moderately moist and close position, where in ten or fifteen days they will make roots. The foregoing ones do best in a temperature of 50° F. *A. cristatum* is easily grown from spores, and is very useful for fern-dishes. (Nichol N. Bruckner.)

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A. *Sori linear or oblong, straight, borne on the back of the lf.* (*Nos. 1–26.*)

B. *Lf. simple, with a serrate margin.*

1. **serràtum,** Linn. Lf. 1–3 ft. long, on a very short stalk, 2–4 in. wide, gradually narrowed below: sori 1 in. or more long. Fla. to Brazil.

2. **Nìdus,** Linn. (*Thamnópteris Nìdus,* Presl. *A. and T. Nìdus-àvis,* Hort.). BIRD'S-NEST FERN. Fig. 414. Much like the preceding in size and habit of growth, but with entire margined lvs. and with the veins partly united to form a net.

BB. *Lf. lobed or pinnatifid.*

3. **Hemionìtis,** Linn. (*A. palmàtum,* Lam.). Lf. 4–6 in. each way, hastate, with a triangular terminal lobe and 2 lateral ones, and a large, rounded sinus at the base: sori often over 1 in. in length. Spain, Canary Isls. S. 1:586.

4. **pinnatífidum,** Nutt. Lvs. clustered, from a short rootstock, 3–9 in. long, with mostly rounded lobes at the base and terminating in a slender point; texture thick, herbaceous; occasionally rooting at the tip. Pa. to Ala. S. 1:628.

5. **ebenoìdes,** R. R. Scott. Texture thin: lvs. 5–10 in. long, with a few irregular divisions near the base, and a long, slender, much-incised apical portion, occasionally rooting at the apex. A very rare native fern.—One of the very few definitely proved fern hybrids, its hybrid name being *A. platyneuron* × *Camptosorus rhizophyllus.*

414. Asplenium Nidus. ($\times\frac{1}{10}$)

6. **alàtum,** HBK. Lvs. 1¼–2 ft. long, the stalks 4–6 in. long, winged above, the blades 1–1½ ft. long, 3–4 in. broad, deeply pinnatifid, the rachis winged throughout, the lobes 1–1¼ in. long, ½–¾in. broad, herbaceous.—W. Indies and S. Amer.

BBB. *Lf. once pinnate.*

C. *Pinnæ less than ¾in. long, blunt.*

D. *Rachises greenish.*

7. **vìride,** Hudson. Lvs. 3–8 in. long, scarcely more than ½in. wide, with numerous rather distant lfts., which are ovate and deeply crenate: sori abundant, oblique. A subalpine species of N. Eu. and N. Amer. S. 1:661.

DD. *Rachises purplish or blackish.*

8. **Trichómanes,** Linn. Lvs. densely clustered, 3–8 in. long, ½in. wide, with densely crowded oval lfts. which are slightly crenate on the upper side and suddenly narrowed at the base. Northern hemisphere generally. A.G. 13:653. S. 1:653. Gn. 59:318 (as *A. incisum*).

9. **resíliens,** Kunze (*A. pàrvulum,* Mart. & Galeotti). Lf. 5–9 in. long, with 20–30 pairs of mostly opposite lfts., which are ¼–⅜ in. long, rounded at the outer margin and squarely truncate at the base. Southern states and Mex.

CC. *Pinnæ ¾–1 in. long, with a strong auricle at the upper side of the base or deeply incised on the upper margin.*

10. **platyneûron,** Oakes (*A. ebenèum,* Ait.). Lvs. 6–15 in. long, with 30–35 pairs of lfts. which have an enlarged auricle at the upper side at the base, the lower lfts. reduced to mere triangular auricles: sori, when mature, covering the entire surface. Canada to S. Amer. A.G. 13:654. S. 1:535.

11. **formòsum,** Willd. Lvs. 12–16 in. long, with numerous alternate pinnæ which are mostly deflexed, with the upper margin deeply incised and the lower margin toothed: sori 3–5 to each lft. Trop. Amer. S. 1:576.

12. **ténerum,** Forst. (*A. Veitchiànum,* Hort.). Lvs. 1–1¼ ft. long, the stalks 4–6 in. long, grayish, the blades 8–15 in. long, 3–4 in. broad, 1-pinnate with 10–20 pairs of stalked pinnæ, the pinnæ 1–1½ in. long, ¼–⅜in. broad, rounded, toothed, inequilateral, usually auricled. Asia, Malaya.

13. **Colénsoi,** Col. Stalks 3–4 in. long, with small scales: lf.-blades 4–5 in. long, 2 in. broad; pinnæ numerous, spreading, the lower pinnatifid auricled, on stalks ¼–½in. long. New Zeal.

CCC. *Pinnæ 2–6 in. long, linear or lanceolate.*

14. **angustifòlium,** Michx. Lvs. 18–24 in. long on stout stalks, 4–6 in. wide, with 20–30 pairs of nearly sessile pinnæ, which are truncate at the base and extend to a tapering point; fertile pinnæ narrower and more distant. Moist woods northward. S. 1:496.

15. **salicifòlium,** Linn. Lvs. 12–18 in. long, with about 20 distinctly stalked horizontal pinnæ, which are wedge-shaped at the base, and curve upward to a long point: sori strongly oblique to the midrib, wide apart, not reaching either margin or midrib. W. Indies to Brazil.

16. **caudàtum,** Forst. Stalks 4–6 in. long, densely clothed with fine fibrillose scales: blades 12–18 in. long, 4–8 in. broad, with 20–30 pairs of pinnæ, the pinnæ 3–4 in. long, ½–1 in. broad, acuminate, deeply toothed, auriculate above. Polynesia, Malaya.

17. **lùcidum,** Forst. Stalks 3–6 in. long, grayish, densely clothed with large gray scales, the blades 1–2 ft. long, 4–8 in. broad, oblong, or ovate-deltoid, with a terminal pinna and 15–20 pairs of lateral pinnæ; pinnæ 4–6 in. long, 1–1½ in. broad, acuminate, toothed. New Zeal.

BBBB. *Lf. 2–4 pinnate.*

C. *Ultimate divisions linear or cuneate: venation somewhat fan-shaped: texture thick.*

18. **Báptistii,** Moore. Lf. bipinnate, with broadly ovate pinnæ 5 in. or more long, each with about 4 stipitate linear toothed pinnules; sori nearly parallel with the midvein and close to it; rachises scaly, with purplish lined scales. South Sea Isls.

19. **affìne,** Swartz. Lf. 9–18 in. long, with numerous pinnæ on either side, the lower ovate deltoid, the upper lanceolate; pinnules incised: sori linear. Mauritius and Ceylon to E. Indies.

20. **Adiántum-nìgrum,** Linn. Stalks brownish, lvs. 3-pinnatifid from winged rachises, triangular, 5–9 in. long; ultimate divisions ovate, sharply incised and serrate on both sides. Old World generally. S. 1:486.

21. **cuneàtum,** Lam. Lvs. 12–16 in. long, 4–6 in. wide, tripinnate below, the ultimate divisions broadly obtuse above and strongly cuneate below: sori linear, usually long for the size of the segms. Tropical regions generally.

22. **frágrans,** Swartz (*A. fœniculàceum,* Kunth). Lvs. 2–3-pinnate; ultimate segms. lanceolate, sharp-serrate above; veins simple or the lowest forked: sori

oblong, extending from midrib to near base of the lobes: petiole brownish, rachis flattened. W. Indies. S. 1:577.

cc. *Ultimate divisions rhombic, sharply spinulose: texture herbaceous.*

23. fontànum, Bernh. Growing in dense clusters: lvs. 3–6 in. long, 1 in. or more wide, 2-pinnate; segms. with 2–5 spinulose teeth which are widely divergent: sori at maturity covering nearly the entire surface of the segms. England and Spain to the Himalayas. S. 1:574.

415. Asplenium myriophyllum. (×¼)

ccc. *Ultimate divisions longer, not spinulose: texture membranous or herbaceous.*

24. bulbíferum, Forst. (*A. láxum,* Hort.). Lvs. 1–1½ ft. long, 6–8 in. wide, 3-pinnatifid; pinnæ tapering to a slender toothed point: often bearing bulbs from which new plants originate while still attached to the lf. Afr. and Australasia. S. 1:508. Gn. 72:156.

25. myriophýllum, Presl. (*A. rhizophýllum,* Kunze). Fig. 415. Growing in extensive tufts, with grayish brown stalks and rachises: lvs. 6–15 in. long, 3-pinnate or 4-pinnatifid, the ultimate segms. frequently deeply 2-lobed with a single sorus to each division. Fla. to S. Amer.

26. cristàtum, Lam. (*A. cicutàrium,* Swartz). Lvs. 3-pinnatifid with a winged rachis, 8–18 in. long; pinnules ovate, with 5–7 narrow divisions, each bearing a single sorus; texture thin, membranous. Trop. Amer., rare in Fla.

aa. *Sori linear, marginal or submarginal, on narrow, linear, ultimate divisions of the lf.* (*Darea.*)

b. *Lvs. bipinnatifid, less than a foot long.*

27. oceánicum, C. Chr. (*A. obtusílobum,* Hook., not Desv.). Lvs. 4–7 in. long, 2 in. wide or less, with about 10 pinnæ, which are made up of 5–7 narrow segms. bearing occasional sori in the outer margin of the segms. New Hebrides and Fiji Isls. S. 1:625.

bb. *Lvs. 2-pinnate or 3-pinnatifid, over a foot long.*

c. *Pinnæ short, with close segms.*

28. rutæfòlium, Kunze. Lvs. 13–15 in. long, with 12–20 pinnæ on each side, each with 7–11 narrow segms., 2 or 3 of the lower ones 2-fld. or rarely 3-fld. S. Afr., India and Japan.

29. Belángeri, Kunze. Fig. 416. Lvs. 15–18 in. long, 3 in. wide, with numerous horizontal pinnæ on each side, cut into about 12 slender linear segms. on either side, which are set nearly at right angles to the rachis; the lower basal segms. often forked. Each segm. has a single sorus, and 1 vein. This species is thought by some fern students to be merely a divided variety of *A. tenerum,* Forst. (No. 12). In general the two species are much alike. E. Indies.

30. dimórphum, Kunze. Stalks 6–12 in. long, naked: blades 2–3 ft. long, 12–15 in. broad, ovate-deltoid, 2–3 pinnate; sterile lvs. 2-pinnate, segms. ovate 1 in. long, ½in. broad, bluntly toothed; fertile lvs. 3-pinnate, segms. linear, each with a single sorus. Norfolk Isl.

cc. *Pinnæ longer, with scattered narrowly linear segms.*

31. vivíparum, Presl. Lvs. 15–24 in. long, 6–8 in. wide, on rather short stalks with pinnatifid pinnules and ultimate segms., which are narrowly linear and often forked: plant often bulb-bearing, like *A. bulbiferum.* Mauritius and Bourbon. Cult. under various names. S. 1:662. **A. nóbilis,** Hort., is a more vigorous variety, originally from New Guinea.

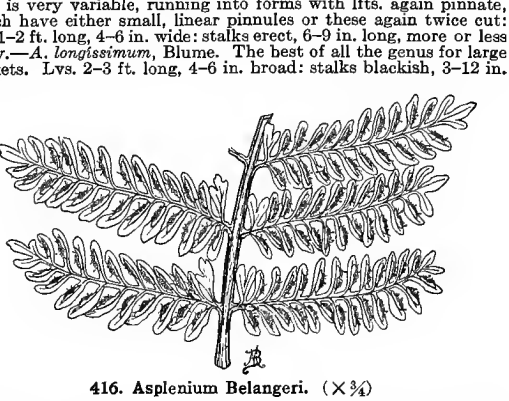
aaa. *Sori more or less curved, sometimes horseshoe-shaped: lvs. ample, 2–4-pinnatifid.*

32. Filix-fœmina, Bernh. Lvs. 1½–3 ft., broadly ovate-oblong, bipinnate; pinnæ 4–8 in. long, lanceolate, with numerous more or less pinnately incised or serrate segms. Eu. and N. Amer.—Very variable, especially in cult. Schneider describes 56 varieties.

33. acrostichoìdes, Swartz (*A. thelypteroìdes,* Michx.). Lvs. 1–2 ft. long, on long, straw-colored stalks, 6–12 in. wide, 2-pinnatifid, with linear-lanceolate pinnæ; segms. crowded, oblong, minutely toothed: sori 10–12 to each segm. Rich soil in the E. U. S. S. 1:651.

34. spinulòsum, Baker. Lvs. 9–12 in. each way, deltoid, 3–4-pinnatifid, with 9–12 pinnæ on either side, the lowest much the largest; segms. short and sharply toothed. China and Japan.

Supplementary list of less common trade names: *A. aculeàtum,* Hort. Hab.(?).—*A. arbòreum.* See Diplazium.—*A. bífidum*= A. lineatum.—*A. decòrum,* a sport from A. bulbiferum.—*A. decussàtum.* See Callipteris.—*A. ellípticum,* Hort., a trade name.—*A. fláccidum,* Forst. Coolhouse basket fern from Austral., Tasmania and New Zeal. Lvs. 2–3 ft. long, 4–8 in. broad; stipes stout, flexible, greenish, naked; pinnæ numerous, close or distant, lanceolate, leathery, 4–8 in. long, ½–¾in. broad. Very variable.—*A. Goringiànum* var. *pictum,* Mett (Athyrium Goringianum var. pictum, Hort.). Distinguished from all other members of the genus by the bright color of its entirely deciduous lvs., which are 10–15 in. long, spear-shaped, and pendulous. Possibly the only hardy variegated fern. It, however, needs glass protection for best results. Stalks purple or claret-colored: lvs. green with a central band of gray; lfts. divided into sharply toothed pinnules on which the oblong or kidney-shaped sori are arranged in 2 rows parallel to the midvein. Japan.—*A. laceràtum,* Desv. Allied to A. Nidus and possibly a variety of that species. Lvs. narrower, cut into irregular lobes, each lobe having black stripe about 3 in. long. Brazil.—*A. lánceum.* See Diplazium.—*A. Laurèntii,* Christ. var. *denticulàtum.* Allied to A. macrophyllum but smaller. Congo.—*A. lineàtum,* Swartz. Warmhouse species from Mauritius and Bourbon, is very variable, running into forms with lfts. again pinnate, which have either small, linear pinnules or these again twice cut: lvs. 1–2 ft. long, 4–6 in. wide: stalks erect, 6–9 in. long, more or less scaly.—*A. longíssimum,* Blume. The best of all the genus for large baskets. Lvs. 2–3 ft. long, 4–6 in. broad: stalks blackish, 3–12 in. long: lfts. sessile, auricled. E. Indies. S. 1:602.—*A. macrophýllum,* Swartz. Coolhouse species from Polynesia, Malaya, China, and Himalayas. Lvs. 6–18 in. long, 6–12 in. wide: stalks brownish: lfts. 6–12 pairs, stalked, 3–6 in. long, 1–3 in. wide, sharp-pointed, serrate.—*A. Shèpherdii,* Spreng. See Diplazium.



416. Asplenium Belangeri. (×¾)

L. M. UNDERWOOD.
R. C. BENEDICT.†

ASPRÉLLA: *Hystrix.*

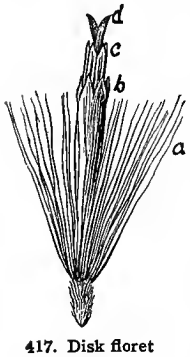
ASTÈLIA (name alluding to epiphytic character of some species). *Liliàceæ.* Greenhouse plants with racemes or panicles of small flowers.

Astelias are perennial herbs of about a dozen species in New Zeal., Austral. and the Pacific Isls., with lvs. all radical or crowded at the base of the st., belonging to the Dracæna tribe: fls. small and dicœcious; perianth

6-parted, persistent, the parts spreading or reflexed; stamens 6, attached to base of corolla-parts; staminodia present in pistillate fls., the ovary sessile, 1–3-celled: fr. an indehiscent somewhat fleshy and globose berry. In New Zeal., the astelias form a prominent part of the vegetation. The species are confused. Two or 3 New Zeal. species have been sparingly intro. to cult. abroad, as: **A. Cúnninghamii,** Hook. f., with 1-celled fr.: fls. numerous and small, greenish yellow or reddish yellow or maroon: a densely tufted species, epiphytic or terrestrial, with lvs. 2–5 ft. long and scape 1–3 ft. B.M. 5175. **A. Bánksii,** Cunn., with 3-celled fr.: fls. larger (about ¼in. long), many, greenish: densely tufted, large, the lvs. 2–6 ft. **A. Solándri,** Cunn., with 3-celled fr.: fls. very numerous and lemon-yellow, ½in. long: densely tufted, often making large clumps on trees and rocks, the lvs. 2–5 ft. B.M. 5503. L. H. B.

ÁSTER (*a star*). Including *Diplopappus*. *Compósitæ*. Aster. Starwort. Michælmas Daisy. A large temperate-zone genus of attractive but botanically-confused, mostly perennial leafy herbs, particularly abundant in North America; very useful for border planting.

The genus is characterized by numerous flattish rays (white, blue, red, or purple), slender subulate or lanceolate style appendages, compressed several-nerved achenes, and an involucre with unequal bracts in few or several rows, the pappus simple, soft, and abundant (Fig. 417); leafy stemmed, mostly blooming in the autumn: lvs. always alternate. It differs from Erigeron in having 2 to several rows of involucrate bracts; in Erigeron there is only 1 series of bracts. Some of the species are annual, but those in cult. are perennial (or rarely biennial). Calimeris and Linosyris, which have yellow fls., a color unknown in aster, are kept distinct in this book.



417. Disk floret of Aster. (×3)
a, pappus; *b*, corolla; *c*, stamens; *d*, styles.

In North America, where the asters are such abundant plants in the autumn flora, the species are not much known as cultivated plants, most of the specimens seen in gardens being the wild species transplanted. In Europe, however, there are numbers of named garden kinds, some of them derived from American species that have been long cultivated there. *A. novi-belgii* has been particularly productive of garden forms. Many of the garden forms are undoubtedly confused hybrids. The Michælmas daisies are mostly from this species and perhaps also from *A. novæ-angliæ*. Many of the Latin-form garden names are very difficult to place.

The native asters are amongst the very best plants for borders and roadsides. They should be better known. *A. acuminatus* grows well in shade in ordinary soil, not necessarily moist; increases in vigor under cultivation. *A. cordifolius* prefers open or partial shade; improves much under cultivation with good soil. *A. corymbosus* prefers at least partial shade, and will grow even in very deep shade; seeds very freely; does well on dry ledges and in small crevices in rock; very tenacious of life. *A. dumosus* prefers full sunlight and dry situation. *A. ericoides* wants full sunlight and dry situation; will grow in very poor or shallow soil, but does best where roots can penetrate deep. *A. lævis* grows in either full sunlight or partial shade and good soil. *A. novæ-angliæ* will not endure much shade; prefers moist soil, but grows well in ordinary garden situations. Fall-sown seedlings of *A. novæ-angliæ* var. *roseus* come practically true to varietal name, though varying in shade of color, and these seedlings bloom later than older plants and at a height of 18 inches, making the plant of value as a late bedding plant treated as an annual. *A. novi-belgii* prefers moist soil; will not endure heavy shade. *A. paniculatus* prefers moist soil, but will do well in rather dry situations; will endure more shade than either of the two above species. *A. patens* wants open or half-shaded places, and good soil; one of the weaker species, often proving short-lived. *A. puniceus* will not endure shade; prefers moist

418. Aster macrophyllus. (×½)

places, but will grow in good soil not over-moist; in dry situations it loses its vigor; spreads rapidly in favored locations. *A. spectabilis* prefers open or partly shaded places; one of the weaker species in wild state; rather short-lived. *A. undulatus* wants open or half shade; late-flowering, handsome plant, forming large clumps when allowed to develop. (F. W. Barclay.)

The garden or modified asters undoubtedly deserve more attention in American collections. The beautiful low-growing, vernal alpine asters are little known at present, but are valuable for rock-garden and for bordering purposes. The earliest asters to flower are the Alpine varieties. These are well adapted for floral mass effects, and transplant well, even in an advanced state. There are many garden varieties of asters, among which are Schoene von Ronsdorf, Ultramarin, Beauty of Colwall, Beauté Parfaite, Rosalind and Boule de Neige. Alpine asters can be easily raised from seed sown in spring. Seedlings do not flower until the second year. In the garden they require a light rich soil, open exposure and moderate amount of moisture. Plants retain their foliage over winter and for this reason need a more careful covering than the tall-growing classes require. Garden varieties of the latter, as a rule, do better in low and rather moist locations. Here a minimum of care is sufficient. To bring out their full beauty, however, it is necessary to plant them in well-prepared richly manured ground and properly to cultivate, stake and irrigate them. Stock of named varieties must be purchased as plants. Propagation can be effected by division of old clumps, or, if larger quantities are

desired, by cuttings. If distinctness of variety and color is no object, seeding may be employed; sow early in spring, thinly in rows; transplant seedlings in August or early in September and await their coming into flower the following season. (R. Rothe.)

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A. *Old World asters, some of them old garden plants, and somewhat modified by cult. Nos. 1–12.*

B. *Sts. simple and scape-like, bearing a single fl., sometimes branched in A. Thomsonii.*

C. *Rays purplish or violet.*

1. **alpìnus,** Linn. Lvs. entire and spatulate, forming a cluster on the ground, those on the st. small and linear: st. 3–10 in., bearing a large violet-rayed, handsome head. B.M. 199. Gn. 76, p. 122.—In its wild state, the plant also occurs in the Rocky Mts. Valuable alpine or rockwork plant, with fls. varying to pink and white. Var. **speciòsus,** Hort., is taller and stronger, with heads 3–4 in. across. Var. **supérbus,** Hort. (Gn. 54:328. G. 32:591), is a large and showy form. Var. **álbus** is a beautiful pure white-fld. form of the type. G.M. 50:617.

2. **Thómsonii,** Clarke. An erect, sometimes laxly branched herb, with slender, flexuous, hairy branches: lvs. 2–4 in. long, almost clasping at the base: fls. solitary, 1½–2½ in. wide, the rays reddish purple, about 20–30 in each head. Himalaya region. Gn.W. 23:27. Gn. 42, p. 295.—To be treated as an alpine near N. Y. Perhaps better referred to Calimeris.

419. Aster cordifolius. A handsome blue-flowered native aster. (×½)

CC. *Rays predominently blue or lilac.*

D. *Plants low, not over 1 ft. in height.*

3. **himalàicus,** C. B. Clarke (*A. himalayénsis,* Hort.). Similar to *A. alpinus,* but dwarfer: rays lilac-blue, slightly recurved at the tip: sts. 4–12 in., slightly villous: lvs. oblong or elliptic, nearly entire. Himalayas, 13,000–15,000 ft.—Little known in Amer.

4. **subcærùleus,** S. Moore. Erect herb from a tufted mat of foliage with sessile, nearly oblong lvs., all a little hairy: lvs. entire or sometimes slightly denticulate: fls. large, solitary on long stalks, at least 2 in. wide, the rays a beautiful pale blue, the disk yellow; involucral lvs. broadly oblong, ciliate. N. W. India. June. G. 32:449. G.C. III. 38:23. G.M. 48:411. Gn. 68, p. 11.—Needs protection N. June.

5. **pyrenæus,** DC. St. erect, simple, 10–18 in. high: lvs. sessile, roughly pubescent, oblong-lanceolate and prominently 3-nerved: fls. solitary or 2 or 3 together, at least 2½ in. wide, the numerous rays lilac, the disk-fls. yellow. S. Eu. Aug., Sept.

DD. *Plants 2–3 ft. high.*

6. **diplostephioìdes,** Benth. Two to 3 ft., soft-pubescent or hairy, the st. simple and solitary: lvs. obovate or oblanceolate, entire but ciliate: solitary head large, inclined, 2–3 in. across, blue or pale purple, very showy. Himalayas. B.M. 6718. J.H. III. 33:262. G.C. III. 48:56. G.M. 35:445.—In the American trade has been misspelled *A. Deptostaphides.* Var. **Fálconeri,** Clarke (*A. Fálconeri,* Hort.), from Cashmir, has very large sky-blue heads.

BB. *Sts. usually branched and several- to many-fld.*

7. **Amèllus,** Linn. St. simple or nearly so, few-fld. or sometimes only 1-fld.: lvs. oblong-lanceolate, obtuse, somewhat serrate, more or less 3-nerved, roughish, pubescent: involucre scales oblong, obtuse or nearly so, spreading, in 4–5 rows; heads large, purple. Eu. and

420. Aster novæ-angliæ. One of the best and most showy of native asters. (×⅓)

Asia. Gn. 27, p. 202; 35:172.—Variable, and several well-marked garden forms.

8. Var. **bessarábicus,** DC. (*A. bessarábicus,* Bernh.). Lvs. oblong and attenuated at base: plant taller and larger-fld., deep purple. G. 21, p. 167. Gn. 35, p. 173; 75, p. 511.—Showy and desirable.

9. **sibíricus,** Linn. A foot or sometimes nearly 2 ft. high, somewhat pubescent, each branch terminating in a single head: lvs. oblong-spatulate to broad-lanceolate, serrate, almost clasping the st.: heads violet or lilac.

Arctic Eu. and Amer., and Rocky Mts.—Excellent rockwork plant.

10. **àcris,** Linn. About 2–3 ft., slender-branched: lvs. linear, or lance-linear: heads large and blue, with long, distinct, handsome rays. S. Eu. Gn. 37:240. G.M. 34:615.—Excellent showy garden plants. A dwarf form is *A. cànus.* Var. **nànus** is a very dwarf form, not exceeding 15 in.

11. **trinêrvius,** Roxbg. About 3 ft., stout, corymbose at summit: lvs. lance-ovate, 1–4 in. long, usually rough on both sides and strongly toothed: heads large, blue or purple (a pale variety) with narrow, spreading rays. Himalayas. R.H. 1892:396.—Hardy, handsome, variable.

12. **tatáricus,** Linn. f. St. erect and striate, hispid, corymbose at the summit, often 7 ft. high: lvs. large (the radical 2 ft. long), lanceolate or oval lanceolate, attenuate at base, entire: involucre scales purplish at

421. Aster Herveyi. (×½)

tip; heads blue or purple, late. Siberia. G.F. 4:197.—Excellent for the hardy border, particularly for its very late blooming. Var. **Petersiânus,** Hort., has narrower lvs. and pale blue rays and yellow disk. China.

AA. *Native Asters.* These plants are one of the charms of the American autumn, and are amongst the best of all hardy border plants. They usually improve greatly in habit when transferred to cultivated grounds. Any of these wild asters are likely to come into cultivation at any time. The number of kinds is large. The student will find them all described in Gray's Synoptical Flora of North America, 1, pt. 2. Those of the northeastern states and adjacent Canada will be found in Britton and Brown's Illustrated Flora of the United States and Gray's Manual. Those of the South are described in Small's Flora of the Southeastern States, and those of the Rocky Mountains in Nelson's Manual of Rocky Mountain Botany. The following comprises those known to be in cultivation. Of these, *A. novæ-angliæ* is the best known in domestication. The species are much confused.

B. *Basal and lower lvs. cordate and slender petioled.*

C. *Plant glandular: rays violet.*

13. **macrophýllus,** Linn. Fig. 418. Perennial about 2½ ft. tall with reddish angular st.: lvs. cordate and petioled below, on the upper part of st. sessile and acute: rays about 16, violet-lavender, the involucrate bracts prominently green-tipped. E. N. Amer. G.F. 4: 89 (adapted in Fig. 418).—Suitable for dry shady places.

CC. *Plants not glandular: rays blue or purple.*

14. **Shôrtii,** Hook. Perennial, 3–4 ft., with a rough, usually slender paniculately branched st.: lvs. thick, usually quite smooth, the lower cordate, the upper lanceolate and quite entire and those of the small branches bract-like: heads very numerous, the 10–15 violet-blue rays showy and linear. S. E. U. S. G.F. 4:473. G.C. III. 32:269.—Cult. easy, even in dry rocky places.

15. **cordifòlius,** Linn. Fig. 419. Perennial, much-branched herb, 3–4½ ft.; with a smooth st. and thin, rough, usually hairy lvs., the lower cordate, the upper ovate or lanceolate: heads very numerous, not over ½in. diam., the pale blue rays usually 10–20 in number. Cent. N. Amer. Gn.M. 3:211.—Can be grown almost anywhere. There are many varieties, the best being var. **polycéphalus** with more heads than the type. Gn. 40, p. 337.—In cult. it has varied much and is prized abroad. *A. élegans* is probably a form of it. Var. **magnificus** is large with many small fls.

BB. *No cordate and petioled lvs.: those of the st. with clasping bases.*

C. *St. rough or hirsute, pubescent.*

16. **nòvæ-ángliæ,** Linn. NEW ENGLAND ASTER. Fig. 420. A stout-std. corymbosely branched perennial, 3–5 ft.: lvs. oblong-lanceolate, clasping the st., hairy, 2½–4 in. long: fls. numerous, showy, the 40–50 violet-purple rays about ½–¾in. long. E. N. Amer. A.F. 9:283.—The best and most widely known native aster suitable for open places but partial to moisture. Var. **ròseus,** Hort., an excellent rose-colored form, is offered by some dealers. Many cult. forms in European collections.

CC. *St. quite smooth.*

17. **lævis,** Linn. (*A. decúrrens,* Hort.). Perennial, with stout often glaucous st., 2–3 ft.: lvs. thick, sharply toothed, often rough-margined, the upper strongly st.-clasping: heads numerous, about 1 in. wide, the 15–30 blue or violet rays acutish. N. E. N. Amer.—There are several varieties, but apparently not known to the trade.

18. **nòvi-bélgii,** Linn. NEW YORK ASTER. Widely variable, slender-std. perennial, 2–3 ft.: lvs. lanceolate, or oblong-lanceolate, entire, smooth, 2½–5 in. long: heads many, in a corymbose-paniculate infl., the 15–25 rays a rich violet. Atlantic coast from Maine to Ga.—Suitable for moist places. Many garden varieties and hybrids are known, but they are mostly confined to the European trade. *A. éminens* and *A. cæspitòsus* probably belong here.

BBB. *Lvs. neither cordate nor st.-clasping.*

19. **Hérveyi,** Gray. Fig. 421. A rough-std. perennial, 2–3 ft., with firm lvs. that are rough above, hairy on the veins beneath, 2½–5 in. long, and toothed: heads numerous, about 2 in. broad, with 15–25 violet rays, very showy. New England. G.F. 2:473 (adapted in Fig. 421). Good for dry sandy soil.

20. **ericoìdes,** Linn. WHITE HEATH ASTER. FROST-WEED ASTER. A smooth-std. perennial with paniculately, much-branched facies, 2–3 ft.: lvs. slender, those of the st. narrowly linear and acute, not over 2½ in. long, usually shorter: fls. very numerous, the heads not over ¾in. wide, and composed of 15–25 white rays.

Not very showy. E. N. Amer. J.H. III. 49:465. Gn. 32, p. 318.—Useful for naturalizing in open dry situations.

Besides these, many other native species are from time to time found in the catalogues of dealers in native plants. The most common are:

A. acuminàtus, Michx.; *A. amethýstinus*, Nutt. (G.F. 5:378); *A. Andersonii*, Gray; *A. Bigelovii*, Gray (B.M. 6430); *A. canéscens*, Pursh; *A. carnòsus*, Gray; *A. caroliniànus*, Walt.; *A. Chamissònis*, Gray; *A. Chápmanii*, Torr. & Gray; *A. commutàtus*, Gray; *A. cóncolor*, Linn. (Mn. 10:161); *A. conspícuus*, Lindl.; *A. corymbòsus*, Ait.; *A. Cùsickii*, Gray; *A. diffùsus*, Ait., and var. *horizontàlis*; *A. Douglasii*, Lindl.; *A. Drúmmondii*, Lindl.; *A. dumòsus*, Linn.; *A. falcàtus*, Lindl.; *A. Féndleri*, Gray; *A. foliàceus*, Lindl. (*A. foliòsus*, Hort.?); *A. Frèmontii*, Gray; *A. grandiflòrus*, Linn. (G.C. III. 45:36); *A. Hállii*, Gray; *A. integrifòlius*, Nutt.; *A. linariifòlius*, Linn.; *A. Lindleyànus*, Torr. & Gray (Fig. 422), (G.F. 2:449, adapted in Fig. 422; G.M. 34:615); *A. longifòlius*, Lam. (G.F. 9:507); *A. Ménziesii*, Lindl.; *A. multiflòrus*, Ait.; *A. nemoràlis*, Ait.; *A. oblongifòlius*, Nutt.; *A. paniculàtus*, Lam.; *A. pàtens*, Ait., and var. *Meèhanii*; *A. polyphýllus*, Willd.; *A. Pòrteri*, Gray; *A. prenanthoìdes*, Muhl.; *A. ptarmicoìdes*, Torr. & Gray (G.F. 3:153); *A. pulchéllus*, Eaton; *A. puníceus*, Linn. (G.M. 34:615), (Fig. 423), and var. *lœvicaùlis* and var. *lucidulus*; *A. radulìnus*, Gray; *A. sagitifòlius*, Willd.; *A. salicifòlius*, Ait.; *A. seríceus*, Vent. (G.F. 5:473); *A. spectábilis*, Ait. (Mn. 5:41); *A. surculòsus*, Michx. (G.F. 5:521); *A. tanacetifòlius*, HBK.; *A. Tradescántii*, Linn. (B.M. 7825); *A. turbinéllus*, Lindl. (G.F. 6:17; Gn. 32, p. 319); *A. undulàtus*, Linn.; *A. versícolor*, Willd. (J.H. III. 49:309).

In the following list, those marked * are offered by dealers: *A. brachytrìchus*, Franch. Dwarf: disk.-fls. yellow, ray-fls. blue. Yunnan, part of China. R.H. 1900:369.—**A. coccíneus nevadénsis* =(?).—**A. Dátschii*=(?).—**A. hýbridus nànus*=(?). "Rosy color, only 6 in. high."—**A. lancifòlius califórnicus*=(?).—**A. décima*, Hort., white to pink=(?).—**A. delicàta*, Hort., pale flesh-color=(?).—**A. gracíllimus*, Hort., white changing to rosy pink =(?).—*A. Ibèris*, of gardens: 20 in. high, of compact even growth: fls. rich blue. Probably a form of Amellus.—**A. lilacinus nevadénsis* =(?).—*A. Linosýris*, Bernh.=Lynosyris vulgaris, Cass., which see. —**A. mèsa grânde speciòsa grandiflòra*, dark purplish blue=(?). R. B. 36:117.—**A. Meèhanii*, Hort., is a well-marked form of A. patens, found by Joseph Meehan at Antietam.—**A. nòvæ-cærùleus*=(?). —**A. pyramidàlis*=(?). —*A. Reèvesii*, Hort., is A. ericoides var. Reevesii, Gray, a "rigid form, comparatively stout, glabrous, except that the lvs. are often hispidulous-ciliate toward the base, the heads and rays as large and the latter about as numerous as in A. polyphyllus." N. Amer.—**A. rotundifòlius*, Thunb. = Felicia. —*A. sikkiménsis*, Hook. Three to 4 ft., stout and erect: lvs. lanceolate-acuminate, spinulose-serrate: heads purple, in large corymbs. Himalayas. B.M. 4557. J.F. 1, pl. 91.—*A. Strácheyi*, Hook. Stemless and sarmentose, with 1-fld. bracted scapes: radical lvs. spatulate, hairy: heads lilac-blue, 1 in. across. Pretty. Himalayas. B.M. 6912. G. M. 31 : 358. —**A. terminàlis*=(?).—*A. Tównshendii*, Hook.= A. Bigelovii, Gray. N. Amer.

N. Taylor.†

422. Aster Lindleyanus. (×½)

423. Aster puniceus. (×⅛)

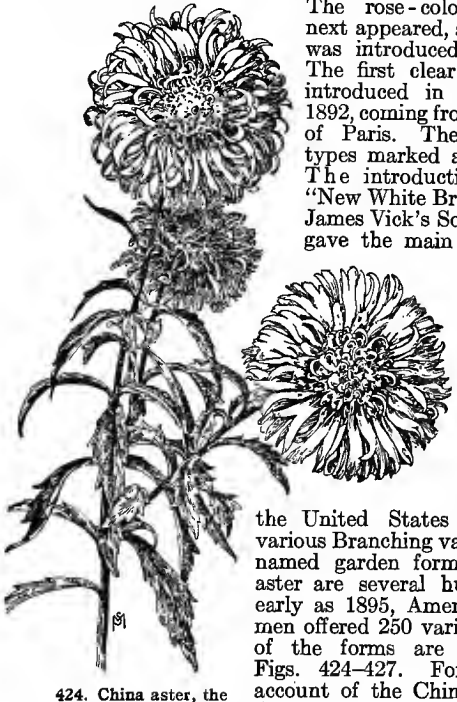
ASTER, CHINA

(*Callístephus hortènsis*). One of the most popular of all garden annuals, being particularly valuable for its fall blooming.

The evolution of the China aster suggests that of the chrysanthemum at almost every point, and it is, therefore, a history of remarkable variations. The plant is native to China. It was introduced into Europe about 1731 by R. P. d'Incarville, a Jesuit missionary in China, for whom the genus Incarvillea of the Bignonia family was named. At that time it was a single flower; that is, the rays or ligulate florets were of only two to four rows. These rays were blue, violet or white. The center of the flower (or head) was comprised of very numerous tubular, yellowish florets. Philip Miller, the famous gardener-botanist of Chelsea, England, received seeds of the single white and red asters in 1731, evidently from France; and he received the single blue in 1736. In 1752 he secured seeds of the double red and blue, and in 1753 of the double white. At that time there appears to have been no dwarf forms, for Miller says that the plants grew 18 inches or 2 feet high. Martyn, in 1807, says that, in addition to these varieties mentioned by Miller, there had then appeared a "variegated blue and white" variety. The species was well known to American gardeners at the opening of the last century. In 1806 M'Mahon, of Philadelphia, mentioned the "China aster (in sorts)" as one of the desirable garden annuals.

Bridgeman, a New York seedsman, offered the China and German asters in 1837 "in numerous and splendid varieties," specifying varieties "alba, rubra, cerulea striata purpurea, etc." In 1845, Eley said that "China and German asters" "are very numerous" in New England. This name German aster records the fact that the first great advances in the garden evolution of the plant were made in Germany, and the seed then used came largely from that country. The first marked departure from the type appears to have been the prolongation or great development of the central florets of the head, and the production of the "quilled" flower. This type of aster was very popular fifty and sixty years ago. Breck, in the first edition of his "Flower Garden," 1851, speaks of the great improvement of the aster "within a few years" "by the German florists, and others," and adds that "the full-quilled varieties are the most highly esteemed, having a hemispherical shape, either a pure white, clear blue, purple, rose, or deep red; or beautifully mottled, striped, or edged with those colors, or having a red or blue center." About sixty years ago the habit of the plant had begun to vary considerably, and the progenitors of our modern dwarf races began to attract attention. The quilled, high-centered flower of a generation or more ago is too stiff to satisfy the tastes of these later days, and the many flat-rayed, loose and fluffy races are now most in demand, and their popularity is usually greater the nearer they approach the form of the uncombed chrysanthemums.

The China aster has long since varied into a wide range of colors of the cyanic series—shades of blue, red, pink and purple. The modern evolution of the plant is in the direction of habit and form of flower. There are various well-marked races or types, each of which has its full and independent range of colors. The Comet type (with very flat rays), now one of the most deserving of the China asters, illustrates these statements admirably. This Comet form—the loose, open flower with long, strap-like rays—appeared on the market about 1886 or 1887, with a flower of a dull white overlaid with pink. The pink tended to fade out after the flower opened, leaving the color an unwashed white. The rose-colored Comet next appeared, and the blue was introduced in 1890. The first clear white was introduced in America in 1892, coming from Vilmorin, of Paris. The Branching types marked a departure. The introduction of the "New White Branching" by James Vick's Sons, in 1893, gave the main impetus to the commercial development of the aster in America. It is probable that more than one-half of all the asters now grown in the United States are of the various Branching varieties. The named garden forms of China aster are several hundred. As early as 1895, American seedsmen offered 250 varieties. Some of the forms are shown in Figs. 424–427. For botanical account of the China aster, see *Callistephus*.



424. China aster, the Comet type. (×½)

It is impossible to construct a satisfactory classification of the China asters. It is no longer practicable to classify the varieties by color. Neither is it feasible to classify them upon habit or stature of plant, for several of the best marked types run into both tall and dwarf forms. Vilmorin, however, divides the varieties into two main groups, the pyramidal growers, and the non-pyramidal growers. The most elaborate classification is that proposed by Barron, from a study of extensive tests made at Chiswick, England. Barron has 17 sections, but they are not coördinate, and they are really little more than an enumeration of the various types or classes. After considerable study of the varieties in the field and herbarium, the following scheme seems to be serviceable:

425. China aster, the Branching type.

A. Flat-rayed asters, in which all, or at least more than 5 or 6 rows of rays, are more or less prominently flat and the florets open.
  B. Incurved or ball-shaped.
  BB. Spreading or reflexed.
AA. Tubular or quilled asters, in which all, or all but the 2 or 3 outer rows of florets, have prominently tubular corollas.
  B. Inner florets short, outer ones longer and flat. Represented by the German Quilled.
  BB. All the florets elongated and quilled.

A grower's classification (Arnold) would be approximately as follows:

Upright.—All the branches erect; plants compact: e. g., Victoria, Truffaut, Giant Comet.

Semi-upright.—Branches few; strong; ascending from base: e. g., "non-lateral" type of Branching.

Branching.—Strong pyramidal habit. Original type much branched.

Spreading.—More open and spreading form than Branching: e. g., Queen of the Market, Early Wonder and Early Hohenzollern.

For growing in borders, one of the best types is the Comet (Fig. 424), in various colors. Other excellent races are the Branching (Vick's Branching is shown in Fig. 425); Truffaut, known also as Perfection and Peony-flowered; Chrysanthemum-flowered; Washington; Victoria, Mignon, and Queen of the Market. The last is commended for earliness and graceful, open habit, and it is one of the best for cut-flowers. Many other types are valuable for special purposes. The Crown or Cocardeau is odd and attractive. Amongst the quilled asters, the various strains of German Quilled (Fig. 426), Victoria Needle (Fig. 427), and Lilliput are excellent. The very dwarf tufted asters are well represented in Dwarf Bouquet or Dwarf German, and Shakespeare. All these are easily grown in any good garden soil. For early bloom, seeds may be started under glass; but good fall bloom may be had, even in the North, by sowing seeds in the open as late as the 1st of June. Asters make very showy bedding plants when grown in large masses, and are also valuable for filling up vacancies in the mixed herbaceous border, where they ought to be planted in clumps, the dwarfer kinds put in front and the taller behind. The colors of asters are not so strong or heavy as to introduce violent contrasts, and for this reason, as well as because of their simple requirements, they are useful and popular.

L. H. B.

The China aster is now grown largely for cut-flowers, rather than merely for garden decoration. Commercially, it is the most important of the cut-flowers that are grown out-of-doors. In the garden of the amateur, it divides honors with the sweet pea. The commercial value of aster seed sold by American seedsmen exceeds that of any other flower. In addition to the large amount of aster seed grown in southern California, New York now produces annually twenty hundredweight of seed, mostly in varieties used by the commercial florist. The principal reasons for the popularity of the aster with florists, aside from its range of useful colors, are its excellent keeping qualities as a cut-flower, its ability to stand rough handling in shipping, and the ease with which it may be grown.

426. China aster of the Quilled type. (×½)

The past ten years have been marked by a decided increase in the use of the artistic Comet type of flower. Many asters of American origin, adapted to American market conditions, have been widely disseminated. "Non-lateral" strains of Branching asters, devoid of side buds, have been produced to meet a need of the florists, and as a result of careful seed-growing, the semi-double aster has nearly disappeared from field and garden. The frequent accidental crossing and re-crossing of widely differing types and a natural tendency toward variation are constantly furnishing material for improvement when asters are grown in quantity and variety. Recent introductions of types of asters show increased size and vigor of plant commonly attributed to a more or less remote Branching cross. Some of the most valuable introductions, like the Rochester and the Crego Pink, appear to be a combination of a Branching plant and a Comet flower.

The Comet aster group has not taken the place, commercially, to which its great beauty would entitle it, because its very long slender petals make it less lasting as a cut-flower than flowers with broader, shorter petals. The slender stems usually correlated with this type of flower, although attractive in cut-flowers, are undesirable in the field. Beautiful single asters have been introduced from Europe, but so far have made little headway against the American prejudice in favor of double flowers.

Classes of asters.

The typical Branching aster is pyramidal in form, large and vigorous, with many lateral branches. It blooms at the close of the season. The abundant leaves are broad and large. The flower is large and deep with the long, rather broad petals irregularly arranged, giving it a soft appearance. The flowers bear well the rough handling incident to ordinary shipping, and if cut before fully mature will last for two weeks. The size and vigor of plant enable the amateur to get fair results with indifferent culture. Modifications of the original type may now be had with flowers having petals variously folded, incurved or whorled and with plants varying to upright in growth and entirely devoid of the many branches that gave the type its name.

The Comet flower is characterized by having petals that are long and narrow and strongly recurved. This gives it a charming light feathery appearance. Originally it was of medium size and bloomed in midseason on upright plants. Comet flowers may now be had on every sort of aster plant. The season includes the earliest and the latest, and the largest aster flowers now grown are of the Comet type.

Queen of the Market was the first of the distinctively early varieties and is still the most largely grown. The plants are open and spreading and the flowers, while smaller and flatter than those of the Branching, have the same general character.

Victoria and Truffaut (or Pæony-flowered Perfection) were for many years the standard varieties and are still grown to some extent. The plants are upright and bloom in midseason. The petals of the Victoria aster are reflexed at the ends; those of the Truffaut aster strongly incurve, making a ball-shaped flower. Both varieties comprise every shade of color known in asters, and these are duplicated in Giant and Dwarf classes.

Cultivation.

Asters thrive in any soil that can be kept in a good mechanical condition. The large late asters are usually the most satisfactory to the amateur. They may easily be grown from seed sown as early as possible in the open ground. Asters transplant readily.

If the plants are started in boxes in the house, the soil should be allowed to dry off on the surface as much as possible between waterings to prevent damping off. Midseason varieties may be grown successfully in this way; but the very earliest varieties need to be started in a greenhouse or an early hotbed.

For market, the extra-early kinds should be sown eight to ten weeks before the soil will permit planting out. They should be kept growing thriftily with a night temperature of about 50° and afterward be thoroughly hardened off in coldframes so that they will not be injured by late frosts after planting out. The soil should be quite as rich as that used for profitable crops of onions or celery; otherwise the flowers will be too short-stemmed. Midseason varieties for market succeed well when started in a mild hotbed. Give plenty of air and avoid overwatering. The last sowing of late varieties is made in the open ground.

427. China aster, Victoria Needle type. (×½)

When growing in large quantities, the seed is sown with a garden drill in rows a foot apart. A transplanting machine, drawn by horses, is used for setting the plants in the field.

The most destructive diseases in the commercial cultivation of asters are various forms of stem-rot. They are of fungous origin and are induced by allowing the plants to remain moist too long at a time. The infection usually takes place in the seed-row, but often no effect is noticed until the plants are nearly full-grown, when they suddenly wilt and die. Covering the soil in the seed-boxes with clean sand, which can be kept dry between waterings, is an effective aid in the prevention of damping-off and stem-rot. The "yellow disease" causes the plants to have a bleached appearance and to make a spindling growth. It is a derangement of the functions of plant-growth caused, so far as known, by irregularity in the moisture-supply. Thorough cultivation of the soil is the best preventive. The presence of "orange rust" is shown by conspicuous orange-colored pus-

tules on the under side of the leaves. The disease can be held in check by thorough spraying with a fungicide. The Pennsylvania blister beetle is so destructive to asters south of the latitude of New York that it is now commonly known as "the aster beetle." It is a large, soft-bodied, black beetle. It feeds on the flower. Spraying with an arsenical poison will control the beetles in the field. Frequent hand-picking can be practised in the garden. The season of this insect is short. The "tarnished plant-bug" causes extensive damage to asters, most of which is commonly attributed to other causes. The inconspicuous yellowish brown insect, smaller than a house-fly, easily escapes notice. The terminal buds that are punctured by the bug, usually die. Frequently the branch becomes diseased and sometimes the entire plant is dwarfed and sickened. The insects cannot be poisoned, but kerosene emulsion and whale-oil soap are effectual deterrents. Asters growing in partial shade are seldom injured by plant-bugs. GEO. ARNOLD.

ASTEROLINOSÝRIS (name derived from *Aster* and *Linosyris*). *Compósitæ.* A plant with "rosy-mauve petals, mixed yellow," reputed to be a hybrid between *Aster àcris* and *A. Linosỳris* (*Linosỳris vulgàris*). Apparently a bi-generic hybrid. *Asterolinosỳris Willmóttiæ* is the only species offered, and apparently not by American dealers. N. TAYLOR.

ASTÍLBE (Greek, meaning *not shining*). *Saxifragàceæ.* Includes *Hotèia.* Ornamental perennial herbs grown chiefly for their showy panicles of white or pink flowers.

Leaves ternately 2–3-pinnate: fls. perfect or dicœcious; calyx 5-, rarely 4-lobed; petals as many, rarely wanting; stamens 10 or 8, rarely 5; pistils 2 or 3, distinct or partly connate: fr. 2 or 3 dehiscent follicles with many minute seeds.—About 14 species in Cent. and E. Asia, Java and E. N. Amer. They look much like Aruncus (which see), and are often called Spiræa. Aruncus and Spiræa are rosaceous genera, and are characterized by many stamens and usually by several to many separate pistils, whereas Astilbe has 10, 8 or 5 stamens (twice the number, or of the same number, as the petals), and a 2–3-lobed pistil (which finally separates into more or less distinct follicles). Astilbe and Aruncus are so much alike that they are often confounded by horticulturists.

428. Astilbe japonica.

The astilbes are perennial herbs, mostly rather tall with handsome compound bright green foliage and small white, pink or almost purple flowers in slender or dense spikes forming large terminal feathery panicles.

They are hardy plants of great merit. They are easily grown in any well-made border and like rich good soil and plenty of water during the growing period. They give conspicuous masses of bloom in summer.

Propagation is mostly by division; also by seeds sown early in spring in the greenhouse; they germinate after two or three weeks; the young seedlings must be pricked off several times and later planted out in frames or in the open ground. The young plants will flower the second year.

Forcing of astilbe.—Few herbaceous plants force with greater ease than *Astilbe japonica*, and its var. *compacta;* but three weeks longer time should be given the latter fully to develop its feathery spikes. Astilbes are so easily and cheaply imported that for the commercial florist it is cheaper to buy than to divide and grow his own plants. When first received, the clumps of roots should be stored, with a little earth or moss between the roots and a little soil over the crown, until the florist is ready to pot them. No amount of freezing does them the slightest harm; but the boxes or flats in which they are stored are best covered with a little straw or litter, and should have the full benefit of rain or snow to keep the roots from drying. From potting or bringing into the greenhouse, it requires from ten to fourteen weeks to bring them into flower, according to the earliness of the season at which they are wanted in flower. The quality of soil is of no consequence, provided it is light and easily handled. They need water in great abundance. Temperature is also of little consequence. Anything above 50° at night will do; but it is best not to flower them in a higher temperature than 60°, or they will quickly wilt when cut or used for decorations. From the time the sprays begin to show white color until they are fully developed, every astilbe should stand in a saucer in which there should be constantly an inch of liquid manure. When sold for window plants or for decoration, astilbes are often disappointing. It is merely want of water. Before the full development of the shoots and leaves, they are easily hurt by tobacco smoke, and should be covered with paper or well wetted when fumigation is necessary. Aphis, spider or thrips never trouble astilbe. As a border plant, astilbe is one of the best of our hardy herbaceous plants; but the feathery plume obtained in the greenhouse is much shorter, more compact, and lacks the pure whiteness of the outdoor-grown specimens. (Wm. Scott.)

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A. *Color of petals white or yellowish white (or changing to pinkish in A. Thunbergii), rarely petals wanting.*

B. *Petals wanting; stamens 5.*

1. **rivulàris,** Ham. Rhizome creeping: st. 3–5 ft.: lvs. 2-ternate, the lfts. ovate, dentate 1–3 in. long; the petioles tawny-hairy like the sts. at the base: fls. yellowish white, in large spikes, which are disposed in panicles; stamens 5, pure white. Nepal, W. China. Gn. 48, p. 355.—Attractive, border species, blooming late. Probably needs protection.

BB. *Petals present at least in the staminate fls.; stamens 10.*

C. *Stamens exceeding the petals: tall, 3–6 ft. high.*

2. **biternàta,** Brit. (*A. decándra,* Don. *Tiarélla biternàta,* Vent.). Somewhat pubescent, 3–6 ft.: lvs. 2–3-ternate, the lfts. ovate and cordate or abrupt at base, sharp-serrate, 2–5 in. long: fls. yellowish white, in a large (10–12 in. long) racemose panicle; petals linear, spatulate in the staminate fls., small or wanting in the perfect ones. June. Woods, Va. and S. B.B. 2:170.—Often confounded with *Aruncus sylvester,* which has numerous stamens not exceeding the broad petals.

3. **grándis,** Stapf. St. 4–6 ft.: lvs. ternately pinnate or 3-pinnate; lfts. ovate to oblong-ovate, doubly serrate, 2–4 in. long, slightly hairy, petiole hairy: panicle 2–3 ft. long with spreading branches; fls. crowded, petals 3 times as long as calyx, stamens longer than petals. July. Cent. China. G.C. III. 38:426. R.B. 33:232.

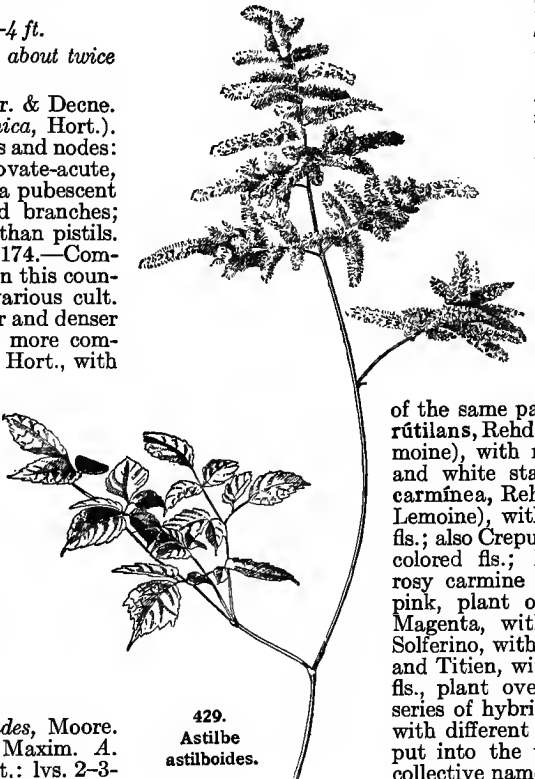
cc. *Stamens shorter than petals: st. 1–4 ft.*

d. *Lfts. distinctly cuneate at the base: petals about twice as long as calyx.*

4. **japónica,** Gray (*Hotèia japónica,* Morr. & Decne. *H. barbàta,* Morr. & Decne. *Spirèa japónica,* Hort.). Fig. 428. Erect, 1–3 ft., hairy on the petioles and nodes: lvs. 3–2-ternate, petiole reddish; lfts. ovate-acute, tapering to the base, serrate: fls. white, in a pubescent racemose panicle with somewhat recurved branches; sepals obtusish, as long or slightly longer than pistils. Japan. B.M. 3821. Gn. 48, p. 366. Mn. 5:174.—Commonly known as a spring glasshouse plant in this country, but hardy in the open. There are various cult. forms, as var. **grandiflòra,** Hort., with larger and denser panicle; var. **compácta,** Hort., the panicle more compact; var. **multiflòra,** Hort.; var. **variegàta,** Hort., with variegated lvs.; var. **purpùrea,** Hort., with purple-shaded foliage.

dd. *Lfts. rounded at the base or occasionally broadly cuneate: petals 2½–4 times as long as calyx.*

5. **Lemòinei,** Lemoine. Foliage graceful, standing 1½ ft. high, with lfts. broad-oval, dentate and crimped, satiny green, hairy: fls. with white petals and 10 pink stamens, very numerous, in plume-like clusters, disposed in panicles 1½ ft. long. Gn. 48, p. 355. R.H. 1895, p. 567. A.F. 11:459.—Garden plant, a hybrid of *A. Thunbergii* and *A. astilboides.* Hardy, and forces well.



429. Astilbe astilboides.

6. **astilboìdes,** Lemoine (*Spirèa astilboìdes,* Moore. *Spirèa Arúncus* var. *astilboìdes,* Hort., not Maxim. *A. aruncoìdes,* Lemoine). Fig. 429. St. 2–3 ft.: lvs. 2–3-pinnate; lfts. ovate to ovate-oblong, 1–2½ in. long, doubly and sharply serrate, hairy: fls. white, crowded in dense spikes, forming a panicle, with straight spreading branches; sepals acutish, shorter than pistils; petals linear-oblong, at least 2½ times as long as sepals. Intro. from Japan. G.C. II. 14:113.—Var. **floribúnda,** is supposed to be a cross of this species and *A. japonica.*

7. **Thúnbergii,** Miq. St. 1–2 ft.: lvs. 2–3-pinnate, the lfts. slender-stalked, ovate, 1½–3½ in. long, serrate, yellowish green, hairy: fls. white, on reddish stalks, often changing to pink, in clusters on rather slender spikes forming a spreading panicle; petals 2½ times as long as the calyx. Japan. F.M. 1881:457. R.H. 1895, p. 565.—A graceful plant. Forces well.

8. **chinénsis,** Franch. & Sav. (*Hotèia chinénsis,* Maxim.). Plant 1½–2 ft., graceful: lvs. ternately 2–3-pinnate; lfts. ovate-lanceolate, doubly serrate, 2–3½ in. long, hairy: fls. in a branchy, rather narrow panicle; petals linear-spatulate, white, 3 or 4 times as long as the yellowish white or pink calyx; stamens lilac; anthers blue. July. China. M.D.G. 1907:547.—Possibly a form of the preceding.

9. **rôsea,** Van Waveren & Kruijft (*A. hýbrida ròsea,* Arends). A hybrid between *A. chinensis* and *A. japonica.* Similar to *A. japonica* in habit, but fls. pinkish. The two best known forms are var. Peach Blossom, with lighter pink fls., R.H. 1908, p. 341, and var. Queen Alexandra, with deeper pink fls. M.D.G. 1911:53.

aa. *Color of petals pink.*

10. **Dâvidii,** Henry (*A. chinénsis* var. *Dávidii,* Franch.). St. 4–6 ft.: lvs. ternately pinnate or bipinnate; lfts. ovate to ovate-oblong, 1–1½ in. long, coarsely and unequally serrate: panicle about 2 ft. long, narrow, with ascending, spike-like slender branches, the lower 4–5 in. long; fls. nearly sessile, crowded, fascicled, bright rose-pink; petals linear; stamens 10, shorter than petals with violet filaments and dark blue anthers. July. N. and Cent. China. B.M. 7880. G.C. III. 32:103. R. H. 1907:40. Gn. 72, p. 179. M. D.G. 1907:545.

11. **rubélla,** Lemoine. A hybrid between *A. Lemoinei* and *A. Davidii* (or *A. Lemoinei*×*A. chinensis* × *A. Davidii*). Similar to *A. Lemoinei,* but fls. rose-colored; panicle more compact than in *A. Davidii.* R.B.34:28. —Other forms of the same parentage are var. **rútilans,** Rehd. (*A. rútilans,* Lemoine), with rosy-carmine fls. and white stamens, and var. **carmínea,** Rehd. (*A. carmínea,* Lemoine), with violet-carmine fls.; also Crepuscule, with flesh-colored fls.; Lumineux, with rosy carmine fls. changing to pink, plant over 3 ft. high; Magenta, with carmine fls.; Solferino, with violet-pink fls.; and Titien, with delicate pink fls., plant over 3 ft. high. A series of hybrids of *A. Davidii* with different species has been put into the trade under the collective name of *A. Arendsii,* Arends. M. D. G. 1907:546. These comprise the following crosses: *A. Davidii* × *A. astilboides,* with rosy-lilac fls. in loose and graceful feathery panicles; stamens and petals much exceeding the sepals; here belong the varieties Juno, with purplish pink fls., plant over 3 ft. high; Venus, also with purplish pink fls.; Vesta, with rosy lilac fls.; and Ceres, with lilac-pink fls. *A. Davidii* × *A. japonica,* with creamy white to pale pink or salmon fls. in dense spikes; petals and the pink stamens not much exceeding the sepals; here belongs Rose Perle. *A. Davidii* × *A. rosea,* similar to *A. japonica* in habit, with purplish pink to salmon or nearly white fls.; this cross may be classed with *A. rubella. A. Davidii* × *A. Thunbergii,* taller, 4–5 ft. high with large feathery panicles, their branches nodding at the tips: fls. pale pink to white.

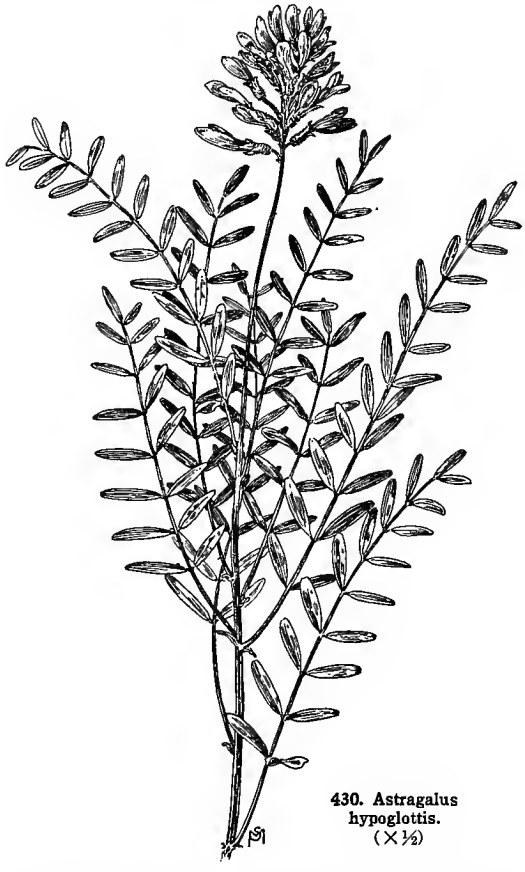
12. **rùbra,** Hook. & Thoms. St. simple, 4–6 ft., long-hairy: lvs. 2-ternate; lfts. oblique-ovate, more or less cordate, 1–3 in. long, sharp-serrate: fls. numerous, rose-red, in compact, robust panicles, with the main branches erect and numerous short lateral branchlets about 1 in. long; stamens 10, shorter than petals. India. B.M. 4959.—Needs protection. Little known in Amer.

A. crenatilobàta, Small (A. decandra crenatilobata, Brit.). Allied to A. decandra. Lfts. crenately toothed, the terminal one usually 3-lobed. N. C.—*A. simplicifòlia,* Makino. Low, not exceeding 1 ft.: lvs. simple, ovate, deeply lobed or incised, about 3 in. long: panicle slender and narrow, the branches short, with star-like white fls. Japan. G.C. III. 48:294; 52:101.—*A. viréscens,* Hutchins. Allied to A. rivularis. Lfts. obliquely cordate-ovate, 3–4 in. long, denticulate: panicles much branched with small greenish white fragrant fls.; petals wanting; stamens 10. China.

Alfred Rehder.†

ASTRÁGALUS (ancient Greek name of some shrub). *Leguminòsæ.* MILK VETCH. Hardy herbs or subshrubs, now and then seen in plantings.

Leaves mostly odd-pinnate, sometimes simple: fls. in spikes or racemes, yellow, purple or white; calyx tubular, its teeth nearly equal; petals clawed, the standard erect; stamens in 2 clusters, the anthers similar: pods fleshy, leathery or papery, not much swollen, as they are in the membranous-legumed Phaca, the nearest relative.



430. Astragalus hypoglottis. (×½)

—About 1,500 species. Many kinds are cult. in the Old World, but those described below are the only kinds commonly sold in Amer. The loco-weed of the prairies, which is said to poison cattle, is *A. mollissimus.* For those below and many others, the student is referred to Britton and Brown's Illustrated Flora, Nelson's Manual of Rocky Mountain Botany, and Rydberg's Flora of Colorado. The botanical characters are mostly found in the pods.

Astragaluses prefer a light, porous soil and no shade. The dwarfer kinds may be placed in the front of the border or in the rockery.

Propagation is chiefly by seeds, which germinate slowly, or by careful division in early spring. Many kinds are likely to die if divided or transplanted, as they are mycorrhizal plants, much dependent on a semi-parasitic organism, which is better left undisturbed.

A. *Fls. yellow.*

alopecuroìdes, Linn. St. erect, strict; height 2–5 ft.: lfts. ovate-lanceolate, pubescent: fls. in thick ovate-oblong spikes, on short, axillary peduncles. Siberia. B.M. 3193.

carolinìanus, Linn. (*A. canadénsis,* Linn.). One to 3½ ft.: lfts. 15–31, glabrous or slightly pubescent, elliptic or oval, obtuse or slightly emarginate at apex: fls. yellowish, ¾–1 in. long, in a dense spike: pods 2-celled, coriaceous, sessile, terete and glabrous. July, Aug. E. N. Amer. L.B.C. 4:372.

Drúmmondii, Douglas. Erect, 10–20 in.: lfts. 19–33, glabrous, oblong or sometimes oblanceolate, and obtuse: fls. yellowish white, the keel rarely tinged with purple, 1–1½ in. long, in a loose spike: pods 1-celled, distinctly stalked, glabrous and grooved. June, July. Plains of Cent. N. Amer. Hook. Fl. Bor. Amer. 57.

AA. *Fls. not yellow.*

B. *Sts. trailing.*

monspessulànus, Linn. St. trailing: height 9 in.: fls. purple, purplish or white, in smaller and looser heads than the above. Eu. B.M. 375.

BB. *Sts. erect or merely decumbent, not trailing.*

C. *Plants not spiny.*

D. *Pods 1-celled.*

flexuòsus, Hook. Four to 15 in., leafy-std. and finely hairy: lfts. 9–21, linear, oblong or oblanceolate, obtuse or emarginate: fls. purplish, ½–¾in. long, the peduncles exceeding the lvs.: pods 1-celled, sessile, cylindric, linear or linear-oblong. June–Aug. Plains of Cent. N. Amer.

alpìnus, Linn. Height 6–15 in.: lfts. 13–25: fls. violet, keel darker: pods 1-celled, black-pubescent. Northern and Arctic regions around the world.

DD. *Pods more than 1-celled.*

hypoglóttis, Linn. Fig. 430. Height 3–24 in.: lfts. 17–25: fls. violet-purple, 6–10 lines long, in dense heads: pods 4–5 lines long, 2-celled, densely villous with white hairs. Eu., Asia, and from Kan. west to Nev. and north to Alaska.—Also a white variety excellent for pots.

caryocárpus, Ker-Gawl. Perennial, the whole plant tomentulose: sts. decumbent, ultimately ascending: lvs. alternate, distant, with 17–25 lfts.: fls. pale violet-purple, the calyx about half as long as the corolla: seeds several in each cell. La. B.R. 176.

adsúrgens, Pall. (*A. Láxmanii,* Jacq.). Fig. 431. Small, erect or mostly decumbent plant, with 15–25 lfts., which are oval to linear-oblong, obtuse and rarely emarginate: fls. purplish, ½–1 in. long, the peduncles exceeding the lvs., the spikes dense: pods 2-celled, sessile, oblong and pointed. June, July. Plains of Cent. N. Amer. Jacq. Hort. Vind. 3:37 (as *A. Laxmanii*).

CC. *Plant spiny: fls. white.*

hórrida, Boiss. A low bristly perennial with spiny lvs. composed of 7–8 pairs of broad lfts.: fls. white in a dense, long-stalked, spike-like cluster. Persia.—Curious and rare, rather than attractive.

A. racemòsus, Pursh. Zigzag, erect st.: lfts. 17–21: fls. yellowish in loose racemes. July. Plains of Cent. U. S.—*A. Róbbinsii,* Oakes. Erect and glabrous: lfts. 9–25: fls. in loose racemes, white or purple: pods 1-celled, flattened. Suitable for rocky places. June, July. N. E. U. S.—*A. Shortiànus,* Nutt. Silvery canescent: lfts. 9–15: fls. blue or violet: pods sessile, 1-celled, strongly curved upward. May, June. Plains of Cent. U. S.

N. TAYLOR.

ASTRÁNTIA (name in allusion to star-like appearance of umbels). *Umbellíferæ.* MASTERWORT. Perennial garden plants, grown for the odd and ornamental umbels and attractive habit.

Glabrous and erect low herbs with dark-colored aromatic roots: lvs. palmately lobed or dissected, petioled, the st.-lvs. often sessile and more simple: fls. polygamous, the sterile long-pedicelled and the fertile short-pedicelled; calyx with 5 foliaceous lobes, more or less tuberculate; petals oblong-ovate, connivent: fr. compressed.—Perhaps a half-dozen species, in Eu. and W. Asia, bearing fls. in leafy-involucred umbels and umbellules, the fls. being white, rose-colored or blush. The astrantias grow a foot or more high, making

interesting branching plants for the border, particularly in moist places. Prop. by seeds, and easily by divisions in autumn or spring.

carniòlica, Wulf. About 1 ft.: radical lvs. 5–7-lobed, the lobes oblong-acuminate, serrate: fls. white or blush: involucel of about 12 entire whitish parts with green red-tinged line. Eu. Attractive. June, July.

màjor, Linn. The commonest species in cult.: 1–3 ft.: radical lvs. 5-lobed, the lobes ovate-lanceolate and more or less parted and toothed, acute: fls. pinkish, or rose, or white: involucel of 20 or less linear-lanceolate entire leafy parts; calyx-lobes lanceolate and spinulose, exceeding the petals. Eu.—Thrives by running water and in partial shade. May, June.

Biebersteìnii, Traut. Small: radical lvs. 3-parted, the middle lobe oblong or obovate and more or less 3-lobed, shárp-serrate: involucel parts oblong, entire or nearly so, equaling the umbel; calyx-lobes lanceolate-acute, equaling the petals. Caucasus.

A. helleborifòlia, Salisb. (A. heterophylla, Willd., A. maxima, Pall.). 2 ft. or less: radical lvs. 3-lobed, serrate: fls. pink: involucre of about 12 ovate-lanceolate bristly parts. Caucasus.—*A. mìnor,* Linn. 8–10 in.: radical lvs. 7–9-lobed, toothed: fls. white: involucre white. Eu.

L. H. B.

ASTRAPÆA: *Dombeya.*

ASTROCÀRYUM (Greek, *astron,* star, and *karyon,* nut; referring to star-like arrangement of the fruits). *Palmàceæ,* tribe *Bactrídeæ.* Spiny palms, stemless or with a short, or tall, ringed caudex.

Leaves terminal, pinnately parted; segms. approximate, equidistant or fasciculate, lanceolate-acuminate or attenuate to the obliquely truncate apex, plicate, whitish beneath, the terminal ones free or confluent, the spiny margins recurved at the base; petiole very short; sheath short, open, the spines of nearly all parts of the plant, in some cases, nearly a foot long: spadices short or long, the finely divided branches pendulous, thickened at the base, thence very slender, long, naked, the floriferous naked basal portion, as it were, pedunculate; spathes 2, the lower one membranous, deciduous, the upper fusiform, coriaceous or woody, open on the ventral side, persistent; bracts of the female fls. broad, imbricated like the bractlets; pistillate fls. with a stipitate male one on either side: fr. rather large, ovoid or subglobose, beaked, smooth or spiny, red or orange.—Species 30. Trop. Amer.

431. Astragalus adsurgens. (×⅓)

Astrocaryums are elegant palms of medium height, very suitable for moderate-sized conservatories. *A. Murumuru, A. mexicanum* and *A. argenteum* are the kinds most commonly met with in collections. The leaves are pinnate, spiny on both sides, even in very young plants, and in small plants, at least in some of the species, the segments are narrow, four or five pairs of these alternating with two very broad ones. *A. argenteum* has the under surfaces of the leaves of a much lighter color than the others.

In a young state, the plants require the temperature of the stove, and after attaining the height of a few feet they may be best grown in a warmhouse, and given plenty of water; also a humid atmosphere. Specimens 8 to 10 feet high fruit freely.

Propagation is by seeds, which are slow in germinating. The soil in which they are sown should be changed occasionally, to prevent it from becoming sour. Be careful not to overpot, or the fleshy roots will decay. G.C. II. 22:522. See *Palms.*

A. *Lvs. scurfy, at least beneath or on the petioles.*

Mùrumuru, Mart. Lvs. 9–12 ft. long; segms. lanceolate, somewhat falcate, rich green above, silvery beneath: sts. 12–15 ft. high, densely covered with stout, black spines 6 in. long. Brazil. I.H. 22:213.

argénteum, Hort. Petioles and under surface of the lvs. covered with silvery white scurf: lvs. arching, wedge-shaped, 2-lobed, distinctly plicate, bright green above; petioles with numerous dark, spreading spines 1 in. long. Colombia. F.R. 3:569.—Perhaps more correctly named *A. Malybo,* Karsten.

filulàre, Hort. Small, slender: lvs. erect, narrowly cuneate, with 2 divergent lobes, inversely sagittate; petioles densely scurfy; rachis scurfy on both sides; spines numerous on the petioles and rachis, and on the principal nerves above; brown. Country unknown.

AA. *Lvs. not scurfy.*

Àyri, Mart. Trunks 18–30 ft. high, 8–12 in. diam., usually cespitose: lvs. 15 ft. long, equally pinnatisect to the apex; petiole plano-compressed, membranaceous on the margins, densely scaly and with scattered spines; lower segms. over 3 ft. long, 1¾–2 in. wide, 2 in. apart, the upper ones 2–2½ ft. long, 1 in. wide, 1¼ in. apart, conduplicate at the base, linear, long, attenuate, pointed, minutely and remotely spiny along the margins, white-tomentose below. Brazil.

mexicànum, Liebm. St. 4–6 ft. high, cylindrical, thickly covered with rings of black, straight, 2-edged spines: petiole 2 ft. long, 4-sided, the 2 upper sides concave, clothed (as is the rachis) with straight black spines; blade 6 ft.; segms. 15–18 in. long, 1 in. wide, alternate, broadly linear, acute, straight, white beneath, with deciduous black spines along the margins. Mex.

A. granatense, Hort., is an unidentified trade name.

J. G. Smith and G. W. Oliver.
N. Taylor.†

ASYSTÀSIA (obscure name). Including *Henfrèya, Dicentranthèra* and *Mackàya. Acanthàceæ.* Hothouse or greenhouse evergreen herbs and shrubs.

Plants erect or scandent: lvs. membranaceous, entire: corolla-tube straight or curved, the spreading limb 5-lobed and nearly or quite regular; stamens 4, unequal; stigma blunt or minutely 2-lobed; fls. white, blue or purple, in axillary or terminal clusters, often very showy.—About 20 species in the Old World tropics. Require the general treatment of Justicia, in intermediate or warmhouses.

bélla, Benth. & Hook. (*Mackàya bélla,* Harv.). Glabrous, upright sub-shrub: lvs. ovate-oblong, acuminate, spreading, short-stalked, sinuate-toothed: fls. lilac, 2 in. long, with a long tube below the flaring throat, the spreading segms. ovate-obtuse, disposed on one side of a raceme 5–8 in. long. S. Afr. B.M.

5797.—A beautiful plant, rarely seen, and thought to be difficult to manage; but it seems to flower readily in fall in our climate, if rested during the previous winter and brought on in the summer. Prop. by cuttings of firm wood in spring or summer. Young plants in small pots often bloom well.

A. coromandelìana, Nees (A. comorensis, Bojer. A. violacea, Dalz. Justicia gangetica, Linn.). Zigzag sub-shrub: lvs. ovate-cordate, wavy; fls. purple, nearly sessile, in 6–10-fld. raceme. India. B.M. 4248. P.M. 14:125. F.S. 2:179.—*A. scándens*, Lindl. (Henfreya scandens, Lindl.). Climbing: lvs. obovate to ovate, thick, entire: fls. large, yellow, white and blush, in a thyrse. Afr. B.M. 4449. B.R. 33:31. F.S. 3:231. L. H. B.

ATÁCCIA: *Tacca.*

ATALÁNTIA (*Atalantia*, one of the Hesperides). *Rutàceæ*, tribe *Citreæ*. Woody plants, now receiving attention in America as stocks for citrus fruits, and as possible parents in breeding new forms of such fruits.

432. Leaf of Atalantia citrioides. (×⅘)

Small trees or shrubs, usually spiny, with persistent coriaceous simple lvs. having prominent netted veins and wingless or very narrowly winged petioles jointed at base of lf.: fls. usually pentamerous, with the stamens free or united into a tube, twice as numerous as the petals; ovary 3–5-celled, with 1 or 2 ovules in each cell: fr. like a small orange with a lemon-like skin. In the typical species, the pulp-vesicles fill the segms., but in some dry-fruited species they are rudimentary; these species constitute the subgenus Rissoa.—Twelve or 15 species are known, ranging from India through the Malayan peninsula to Austral.

A. *Subgenus Euatalantia. Cells of fr. lined with pulp-vesicles.*

monophýlla, DC. (*Limònia monophýlla*, Roxbg., not Linn.). A large shrub or small tree, native to India, Ceylon, Burma, Siam and Indo-China, usually spiny: lvs. glabrous, or sometimes pubescent, 1–3 in. long; petioles short, slightly or not at all winged: fls. borne in axillary panicles; calyx irregularly lobed, split to the base on one side; petals usually 4, stamens 8, the filaments connate and forming a completely closed tube; ovary 3–5-celled: fr. from ½–¾in. diam., with a skin like a lime, globose, with several cells (generally 4), each usually containing 1 seed and filled with pulp-vesicles, making the fr. much like a miniature orange. India, Ceylon, farther India. Ill. Roxbg. Pl. Corom., pl. 83. Wight, Icones, pl. 1611. Engl. in Engl. and Prantl. Nat. Planzenf. III. 4:191; fig. 111, C.D.—This tree, still little known outside of India and Ceylon, is the type of the genus Atalantia, and one of the promising species for trial as a stock on which to graft other citrus frs., and also for use in breeding new types of citrus frs. The frs. yield an oil which in India is considered a valuable application in chronic rheumatism.

433. Cross-section of ovary of Atalantia citrioides. (×1)

macrophýlla, Kurz. (*A. monophýlla* var. *macrophýlla*, Oliver). A small or medium-sized tree, native to the Andaman Isls. and Burma, having ovate-elliptical emarginate lvs. 1½–4 in. long and 1–2½ in. broad: fls. on short axillary racemes; calyx irregularly lobed, split to the base on one side as in *A. monophylla;* stamens connate and forming a tube: fr. large, said to reach 1½–2 in. diam. Andaman Isls., Burma, Malay Peninsula, Bangka Isl.—Little known and is chiefly interesting because of the large size of its frs. Kurz, in his "Forest Flora of British Burma," says of this species: "Berries globose, the size of a wood-apple, glabrous," and gives the size of the wood-apple as 1½–2 in. diam. A tree brought from the island of Bangka, east of Sumatra, and now growing at the Botanical Gardens at Buitenzorg, Java, is considered by Hochreutiner to belong to this species. It is of remarkable size, being a beautiful round-topped tree 40 ft. high with a deeply furrowed trunk 6 ft. in circumference, forking at 3 ft. from the ground and branching profusely at 6½–10 ft. No other species of Atalantia is known to reach this size or to bear frs. so large. This species is of unusual interest for trial as a stock and also for hybridizing with other citrus frs.

434. Atalantia ceylonica. (×½)

citrioìdes, Pierre. A small tree native to Indo-China, usually spiny, having glabrous emarginate oval lvs. 2–3½ in. long (Fig. 432): calyx cup-shaped, not split to the base; stamens connate, forming a tube; ovary usually 3- or 4-celled: fr. resembles a small orange about ¾in. diam., with a roughened glandular skin; cells filled with pulp-vesicles and contain usually a single seed about ⅜in. long (Fig. 433). Ill. H. Lecomte Fl. gén. de l'Indo-Chine, Vol. I, pl. 24, fig. C. 5, 6.—This interesting species is native to Cochin China and Cambodia and has recently been intro. into this country, where it will be tested as a stock and for breeding purposes. Its close relationship to Citrus is shown by the fact that it grows well when grafted on grapefruit.

racemòsa, Wight. A shrub or small tree, differing from *A. monophylla* chiefly in having a regular calyx not split down one side. S. India, Ceylon. Ill. Hook. J. bot. Vol. I, pl. 122: Wight, Icones, pl. 71.

AA. *Subgenus, Rissoa, n. subg., named for A. Risso, b. Nice, 1777, d. 1845, a well-known writer on citrus frs. Rissoa, Arnott, 1836 as a genus. Like Euatalantia, but with dry frs., the cells being nearly filled with 1 or 2 large seeds; pulp-vesicles rudimentary and greatly reduced in number.*

ceylónica, Oliver (*Rissòa ceylónica*, Arn.). Fig. 434. A much-branched spiny shrub or small tree native to Ceylon and India: lvs. lanceolate emarginate, 1¼–3 in. long: fls. borne in crowded cymes; calyx not split on one side; stamens free, alternate ones longer; ovary usually 2-celled with 2 ovules in each cell: frs. about ½–¾in. diam., dry, having only rudimentary pulp-vesicles; containing from 2–4 very large rounded seeds. Ceylon. —This species is of interest chiefly for trial as a stock, since its large seeds would be likely to produce very vigorous seedlings. The dry fr. renders it unpromising for breeding purposes. The figure is from a specimen grown at the Hope Garden, Jamaica.

Guillaumínii, Swingle. A small spiny tree, 10–13 ft. high: young branches angular and pubescent: lvs. oval, more or less pointed at both ends, 2–4 in. long: fls. unknown: frs. ¾–1 in. diam., 3-celled, 2 large seeds in each cell, pulp-vesicles rudimentary. Tonkin. Ill. Notulae systematica. H. Lecomte, Vol. II, p. 162, fig. 1. —A little-known species, interesting on account of its large frs. Because of its large seeds, it should yield vigorous seedlings.

simplicifòlia, Engl. (*Ámyris simplicifòlia,* Roxbg. *Atalántia Roxburghiàna,* Hook. f.). A spineless shrub or small tree: lvs. very large, 4–6 in. long, 1½–2½ in. wide, elliptic, pointed at both ends: stamens free; ovary 2-celled: fr. spherical, rough-skinned, ½–1 in. diam., with large seeds. Malay Peninsula. Ill. Wight, Icones, pl. 72. —An interesting species because of its unusually large lvs.

Imperfectly known species: *A. caudàta,* Hook. f. Lvs. caudate-acuminate, narrowed at base: ovary 2-celled. India.—*A. pubérula,* Miq. Lvs. narrowly oblong-emarginate: twigs, petioles, lf.-bases and midrib puberulous; perhaps a form of A. monophylla.

WALTER T. SWINGLE.

ATAMASCO LILY: *Zephyranthes.*

ATHANÀSIA: *Lonas.*

ATHROTÁXIS (name alludes to the crowded cone-scales). Sometimes spelled *Arthrotaxis. Pinàceæ.* Evergreens, allied to Cryptomeria, Sequoia and Sciadopitys, suitable for planting South, or for use as tub specimens in coolhouses.

Trees, densely branched, monœcious: lvs. small, either short, blunt, scale-like and appressed, or lanceolate and somewhat loosely disposed: staminate fls. in imbricated spiral aments, the anthers 2-celled; pistillate fls. in spirally imbricated aments, 3–6 ovules under each scale, these aments becoming small globular cones with woody scales which are contracted at base and at apex incurved or acuminate or pointed.—Three species in Tasmania; by some considered to be inseparable from the genus Cunninghamia. These plants are little known in cult. Aside from seeds, cuttings may be used for prop.

selaginoìdes, Don (*A. alpìna,* Van Houtte. *Cunninghámia selaginoìdes,* Zucc.). Stout, to 45 ft.: lvs. loose, lanceolate, incurved, acute, ⅛in. or less long, those of young seedlings narrower: cones ½–¾in. diam., the scales lanceolate-pointed. Mts.

cupressoìdes, Don (*A. imbricàta,* Maule. *Cunninghámia cupressoìdes,* Zucc.). Tree, reaching 40 ft., with ascending branches: lvs. broad and obtuse, less than ⅛in. long, thick and keeled, closely appressed to the branches: cones ⅛in. or less diam., the scales rounded at top and bearing a short point.

laxifòlia, Hook. (*A. Doniàna,* Henk. & Hochst.). Tree, 25–30 ft., closely allied to *A. cupressoides:* lvs. imbricate but less appressed, acute, about ⅛in. long: cones larger and scales more acuminate. Mts.

L. H. B.

ATHÝRIUM. A generic name recognized as valid by many well-known fern students. As usually delimited, it includes species of Asplenium (which see) which have some of the sori curved across the subtending veinlets. There are also differences in the stem structure. The species are mostly larger and more herbaceous than those of true Asplenium.

R. C. BENEDICT.

ATRÁGENE: *Clematis.*

ATRAPHÁXIS (ancient Greek name). *Polygonàceæ.* Ornamental shrubs grown chiefly for the white or pinkish flowers produced during the summer.

Low shrubs with spiny or unarmed branches: lvs. deciduous, short-petioled, alternate or fasciculate: fls. small, apetalous in few-fld. axillary clusters forming terminal racemes; sepals usually 5, sometimes 4, the 2 outer ones smaller and usually reflexed; stamens 8, sometimes 6; ovary superior with 2–3 styles free or connate at the base: fr. a small 2- or 3-angled achene enveloped by the enlarged inner sepals. Summer.—About 18 species in Cent. and W. Asia, Greece, and N. Afr.

These plants are of spreading habit, with usually small leaves, attractive with their numerous racemes of white or rose-colored flowers, which remain unchanged for a long time, owing to the persistent calyx. They grow best in well-drained soil and sunny situations, but do not stand transplanting well when older. They are well adapted for planting in rockeries or on rocky slopes and are hardy North. The handsomest of the species is *A. Muschketowii.* Propagation is by seeds sown in spring; the seedlings are liable to rot if kept too moist, or in damp air. Increased also by greenwood cuttings under glass in early summer, and by layers. None of the species is in the American trade.

A. buxifòlia, Jaub. & Spach (Polygonum crispulum, Sims). Height 1–2 ft., spineless: lvs. obovate, crenate, dark green, ½–1 in. long: racemes short. Transcaucasia, Turkestan. B.M. 1065.—*A. frutéscens,* Koch (A. lanceolata, Meisn.). Height 1–2 ft., spineless: lvs. ovate-lanceolate, glaucescent, ⅓–1 in. long: racemes loose. Caucasus, Turkestan, Siberia. L.B.C. 5:489. B.R. 3:254.—*A. Müschketowii,* Krassn. (A. latifolia, Koehne. Tragopyrum lanceolatum var. latifolium, Regel). Erect, 2–3 ft., spineless: lvs. lanceolate, crenate, ¾–2 in. long: fls. white with the anthers and ovary red, ⅛in. across in dense racemes. Turkestan. B.M. 7435. Gt. 40:1344.—*A. spinòsa,* Linn. Height 1–2 ft., spiny: lvs. elliptic, entire, glaucescent, ¼–½in. long: racemes short; sepals usually 4 and stamens 6. S. Russia, Orient, Siberia.

ALFRED REHDER.

ÁTRIPLEX (from a Greek name of orache). *Chenopodiàceæ.* Herbs with inconspicuous flowers, some of which are used for forage under the name of saltbushes, some for hedges or lawn specimens, and one as a garden vegetable, and many succulent weeds of desert regions.

Flowers dicœcious or monœcious, in spicate or paniculate clusters, sometimes bunched in the axils: lvs. usually alternate or some opposite: fr. half or wholly inclosed by the persistent bractlets.—About 125 widely distributed species, often weeds. *A. patula,* in many forms, is a common weedy plant throughout the country.

Atriplex hortensis is a garden vegetable used like spinach; for culture, see *Orach. A. leptocarpa, A. semibaccata* and others have been introduced as supplementary forage plants for arid regions. *A. Breweri* is a popular low hedge plant in southern California.

A. *Garden vegetable (with ornamental-lvd. variety).*

horténsis, Linn. ORACH. SEA PURSLANE. Annual: st. herbaceous, erect: lvs. hastate, cordate, or triangular-oblong, acute, 4–5 in. long, 2½–3 in. wide; petioles 12–18 lines long: fruiting bracts 4–8 lines long, short-pediceled. Var. **àtro-sanguínea,** Hort., is a crimson-lvd. ornamental about 4 ft. high, sometimes grown with amarantus-like plants. Old World. See *Orach.*

435. Atriplex Breweri. Used for hedges in California. (×⅛)

AA. *Ornamental shrubs.*

B. *Shrubs 1–3 feet.*

canéscens, James. A pale, densely scurvy shrub, 1–3 ft. high: lvs. oblanceolate, entire: fruiting bractlets with 4 vertical, reticulated wings. July–Sept. New Mex. to S. Dak. and west to Calif.

Hálimus, Linn. Low-spreading shrub with gray foliage, cult. in Calif. for hedges and for seaside planting: lvs. 1–1½ in. long; petioles 3–4 lines long: fls. purplish: fruiting bracts 1½ lines long, 2 lines wide, sessile, reniform, obtuse, entire: seed compressed, yellowish. Medit. region and S. Afr.

BB. *Shrubs 4–10 feet.*

Bréweri, S. Wats. Fig. 435. Stout woody shrub, 4–6 ft.: lvs. ovate-oblong, silvery gray, somewhat rhombic-cuneate at the base, obtuse and acute at apex, 1–3 in. long: fls. dicœcious, the calyx deeply 4-cleft. At home in sandy, wind-swept places. S. Calif.

lentifórmis, S. Wats. (*Obiòne lentifórmis,* Torr.). Diffusely branched, 4–10 ft., the branches terete, with rigid often spinescent branchlets: lvs. oblong-rhombic, ½–1½ in. long: fl.-clusters small, golden or silvery, the calyx 5-parted. S.W.U.S.—Silvery and tall, growing as the preceding but standing more cold.

N. TAYLOR.†

436. Atropa Belladonna or Deadly Nightshade. (×⅜)

ÁTROPA (after *Atropos,* that one of the three Fates who cut the thread of life). *Solanàceæ.* BELLÁDONNA. A genus of 2 species of Old World herbs of great economic importance. Calyx with 5 ovate leafy divisions, enlarging in fr.; corolla bell-shaped or funnelform. The purple berries are poisonous. The plant is used in medicine and is the source of atropine and other drugs. Not in cult. in U. S. except in botanic gardens.

Belladónna, Linn. Fig. 436. Plant erect, branching, leafy: lvs. ovate, entire, pointed: fls. single or in pairs, nodding on lateral peduncles; corolla blue-purple or often greenish purple. Eu. to India.

N. TAYLOR.†

ATTALÈA (*attalus,* magnificent). *Palmàceæ,* tribe *Cocoíneæ.* A large genus of horticulturally little-known palms, well worth more attention.

Stems spineless, single, usually ringed, sometimes lacking: lvs. usually many in a large erect tuft, pinnate, the numerous lfts. rather regularly placed, but at right angles to the rachis, those above standing erect, those beneath falling below the rachis; young lvs. very attractive but rather stiff in their perfect erectness; petiole concave above, often very fibrous at the base: fls. monœcious or polygamo-dicœcious, on a branched spadix inclosed in a rather woody spathe, at least at first, which appears among the lowest lvs.; spadix ultimately recurving, sessile, bracted, usually yellow: fr. a drupe, sometimes quite large, frequently fibrous-coated.—Because of their slow growth the 20–25 species are not very favorably known to the dealers. All are natives of Trop. Amer. See G.C. II. 22:523.

At least two of the species are of economic importance. *A. Cohune* is the source of a finer oil than that of the coconut, and is also used in making an intoxicating beverage. *A. funifera* is the source of a fine fiber much used in the making of brooms, and in rope-making.

Attaleas must be grown in a tropical greenhouse, with a night temperature not less than 60°. They will do best in a mixture of loam three parts, cow- or horse-manure, one part, and one part of sand.

Propagation is by seeds, which may be placed 2 inches deep in a box to be plunged out-of-doors in summer, covered with moss and watered freely.

A. *Trunks becoming tall, or at least not stemless.*

B. *Bases of the petiole prominently fibrous: old lvs. persistent in A. funifera: trunks 18–30 ft.*

funífera, Mart. PISSABA PALM. COQUILLA. St. 18–30 ft., 8–13 in. diam., smooth: lvs. as long as the caudex, green both sides; petioles with very long hanging fibers; segms. broadly linear-acuminate, in clusters of 3–5, divaricate, very numerous: drupe 4 in. long. Brazil.

gomphocòcca, Mart. St. 20–30 ft. crowned by a magnificent cluster of large (6–9 ft.) lvs.: lfts. very numerous, linear or linear-lanceolate, bright green above, paler beneath; petiole relatively short, very fibrous at the base: spathe slender and woody, the spadix reflexed, but short-stalked and half hidden by the lvs.: fr. fibrous-coated. Costa Rica.—Intro. by Reasoner Bros. in 1911.

BB. *Bases of the petiole not prominently fibrous: trunks 50–100 ft.*

excélsa, Mart. St. 90–100 ft. high in the wild, 16–20 in. diam.: lvs. erect-spreading: pistillate fls. solitary on the branches of the spadix: drupe oblong-cylindric, acute at both ends. Brazil.—A little-known palm among the dealers, but not uncommon in fanciers' collections. Stately in habit and with splendid large lvs.

Cohûne, Mart. COHUNE PALM. Fig. 437. St. 50–60 ft.: lvs. erect, pinnate, the dark green pinnæ 30–50 and 18 in. or less long; petiole flat above and rounded below: drupe broadly ovate, nearly 3 in. long, with a very short beak. Honduras.—Fruit used for soap-making, and exported from Cent. Amer. for that purpose. Used for thatching.

AA. *Without trunks.*

spectábilis, Mart. Stemless, or with a very short caudex: lvs. 18–21 ft. long, erect or spreading, the lower segms. 3–4 ft., the upper 12–16 in., ½in. wide, linear-acuminate: spathe erect: fr. about as large as a hen's egg. Brazil.—Requires plenty of water, as its home is on the banks of the Amazon.

amygdalìna, HBK. (*A. nucífera,* Karsten). Stemless: lvs. 15–18 ft. long, crowded, pinnatisect; segms. 90–100 on each side, ensiform, glabrous above, with hairs along the outer margins beneath, 2⅛–2⅝ ft. long, about 1¼ in. wide; petiole with rusty scales beneath: spadix of male fls. about 18 in. long, with a flattened stalk, inclosed by a thick woody spathe. Brazil.

A. Guichire is a trade name; "extremely long-leaved."—*A. Máripa,* Mart. (A. Mariposa, Hort.). See Maximiliana.

N. TAYLOR.†

AUBRIÈTIA (Claude Aubriet, French natural history painter of last century). *Cruciferæ.* PURPLE ROCK-CRESS. Showy perennial more or less evergreen trailers, excellent for rockwork or edgings.

Allied to Alyssum and Vesicaria: distinguished chiefly by the outer sepals being saccate at base, the shorter filaments toothed, and the valves of the oblong or globose silique convex and not ribbed: lvs. entire or angular-toothed: fls. in shades of violet or purple, in few-fld. bractless racemes: plant canescent or tomentose.—About a half-dozen species, Italy to Persia. The aubrietias are of simple cult. Prop. by seeds, layers or cuttings. They make excellent mats of foliage and bloom.

437. Attalea Cohune.

deltoìdea, DC. Fig. 438. Lvs. oblong-spatulate, deltoid or rhomboid, with 1 or 2 teeth on either side, grayish, narrowed into a very short petiole: fls. in few-fld. lax clusters, the violet or purple petals twice the length of the calyx.—Grows 2–12 in. high. Pretty spring and summer bloomer. Hardy in the N. Very variable, some of the forms being named as if of specific rank. Var. **Bougainvíllei,** Hort. Fls. light violet: dwarf and compact. Var. **Cámpbellii,** Hort. Fls. large, purple: plant large. Var. **Eỳrei,** Hort. Fls. large and long, deep violet. Var. **grǽca,** Hort. (var. *superba*). Dwarf and compact, large-fld. One of the best. Var. **Héndersonii,** Hort., probably the same as *Campbellii*. Var. **Leìchtlinii,** Hort. Profuse bloomer, pink fls. Var. **olýmpica,** Hort. Fls. large, violet, like var. *Eyrei*. Var. **violàcea,** Hort. One of the largest forms. Var. **Mooreàna,** Hort. Compact: fls. blue. Var. **Pérkinsii,** Hort. Fls. deep purple with tiny white eye, the petals rounded: plant strong, 10 in., making a large mat. Gn. 67, p. 344. Raised by F. Perkins, Stratford-on-Avon. Var. **Moerheìmii,** Lemoine. Fls. large, rosy pink or mauve, blooming all summer. Var. **purpùrea,** Hort. Erect in habit: fls. large, purple. Var. **variegàta,** Hort. Lvs. variegated.

L. H. B.

AUCÙBA (Latinized for *Aokiba*, its Japanese name). *Cornàceæ.* Ornamental plants grown for their large evergreen foliage, often handsomely variegated, and also for the bright scarlet fruits.

Shrubs with stout forked branches: lvs. opposite, remotely serrate or nearly entire: fls. dicœcious, small; calyx minute, 4-toothed; petals 4; staminate fls. with 4 stamens, filaments short, with a large disk in the middle; pistillate with an inferior 1-celled ovary, style short with an oblique stigma: fr. a 1-seeded berry-like drupe.—Three species in E. Asia extending west to W. China and E. Himalayas, often considered varieties of one polymorphous species.

The aucubas are evergreens with large, lustrous, and often handsomely variegated leaves, small purple flowers in terminal panicles, elongated in the staminate, short and rather dense in the pistillate plant and with bright scarlet oblong berries forming terminal clusters. Hardy in the southern states about as far north as Washington, D. C., and in sheltered localities even farther north; they are well adapted for city gardens as they withstand dust and smoke to a considerable degree.

In the northern states, aucubas are grown in cool-houses—those adapted to azaleas are excellent—and they are kept evergreen by keeping them in a pit during winter, or by holding them cool and partially dry in the house. They will stand five or six degrees of frost in a pit. From cuttings of half-ripened wood, good specimen plants may be had in two or three years. Fruiting plants, with their numerous bright scarlet berries, are exceedingly attractive, but as the plant is dicœcious, there must be male plants with the female ones. If grown in pots and under glass, the plant must be fertilized by shaking the flowering male plant over the female, or by applying the pollen with a camel's-hair pencil. If the male plant flowers earlier, the pollen may be collected and kept dry until the female plant is in flower; it remains effective for some weeks. In the open, aucuba grows well in any good, somewhat moist though well-drained soil, in a half-shaded position. In pots, it will thrive in a sandy loam with sufficient drainage, and requires plenty of water during its growing period. Fruiting plants should not have too large pots.

They are propagated very easily by half-ripened greenwood cuttings at nearly any time of the year, under glass, and by seeds sown soon after maturity; the varieties are sometimes grafted on the common form in early spring, under glass.

japónica, Thunb. A stout shrub, 4–15 ft.: lvs. usually ovate, 3–8 in. long, remotely and coarsely dentate, obtusely acuminate, shining: petals obtusely acuminate: berries scarlet, rarely white or yellow, usually oblong. From Himalayas to Japan. B.M. 5512. I.H. 11:399. S.I.F. 2:59. F.S. 16:1609. F. 1865:65.—There are a great number of garden forms in cultivation, mostly with variegated leaves; the latter are more often cult. than the green forms. Handsome variegated forms are: Var. **latimaculàta,** Kirchn. (var. *aùreo-maculàta,* Dombrain). Lvs. ovate-oblong with a large irregular yellow blotch in the middle and smaller yellow dots around it. F.M. 10:527. F.W. 1876:353. Var. **variegàta,** Dombrain, not Regel (var. *maculàta,* Regel, var. *pícta,* Hort., var. *punctàta,* Hort.). GOLD DUST TREE. Fig. 439. Lvs. with numerous yellow spots.—The most commonly cult. form. B.M. 1197. F.M. 5:277. R.H. 1866:292. Var. **limbàta,** Bull. Lvs. large, coarsely dentate, with a greenish yellow margin. Var. **bícolor,** Regel. Lvs. with a large yellow blotch in the middle, ovate to ovate-oblong, remotely dentate. The following forms have green lvs.: Var. **angustifòlia,** Regel (var. *salicifòlia,* Hort.). Lvs. narrowly oblong-lanceolate. Var. **cóncolor,** Regel (var. *víridis,* Hort.). Lvs. ovate-lanceolate or elliptic-ovate, remotely and coarsely serrate. Gt. 25:859. Var. **dentàta,** Carr. (var. *macrodónta,* Hort.). Lvs. elliptic, coarsely and long-dentate. Var. **macrophýlla,** Bull. Lvs. large and broad, remotely and slightly dentate. Var. **ovàta,** Regel. Lvs. ovate, coarsely sinuately dentate, dark green, lustrous. Var. **pygmæa,** Regel. Low: lvs. ovate-oblong, remotely and sharply

438. Aubrietia deltoidea. (plant × ⅓)

dentate, bright green, dull. Differently colored frs. distinguish the following forms: Var. **luteocárpa,** Rehd. (*A. luteo-cárpa*, Dombrain) with yellow fr. F.M. 1872: 12. Var. **leucocàrpa,** Matsum. & Nakai, with white fr.—*A. cranifòlia*, once offered in American trade, is probably a form of *A. japonica*. To indicate whether a certain form is a staminate or a fruit-bearing plant, mascula or femina (fœmina) is often added to the varietal name.

A. chinénsis, Benth. Lvs. lanceolate to nearly obovate, entire or toward the apex sharply dentate, sharply acuminate: petals finely and long-acuminate; panicle with scattered short and stiff hairs. China.—*A. himalàica*, Hook. f. & Thoms. (A. japonica var. himalaica, Dipp.). Lvs. usually lanceolate to ovate-lanceolate, entire or dentate, sharply and long-acuminate: panicles densely hairy; petals long and finely acuminate: fr. orange to scarlet. E. Himalayas. F.S. 12:1271. I.H. 6:197. ALFRED REHDER.

AUDIBÉRTIA (*M. Audibert*, of Provence). *Labiàtæ*. Including *Ramòna*. Perennial herbs or sub-shrubs, sometimes grown for bees and in ornamental plantings.

Ten species all from W. U. S. mostly from Calif., related to Salvia, but differing in the calyx being more deeply cleft in front, and in being almost spathaceous: lvs. opposite, usually rugose, sage-like: fls. axillary or terminal, not unlike those of *Salvia officinalis;* corolla with upper lip spreading, 2-lobed or emarginate.

grandiflòra, Benth. St. villous, glandular, 1–3 ft. high: lvs. woolly beneath; lower lvs. hastate, obtuse, 3–8 in. long, coarse; bracts crowded, conspicuous: fls. 1–1½ in. long, red or crimson-purple, in dense, showy clusters. Calif.—Prized for bees.

incàna, Benth. St. woody, tomentose-canescent, leafy: lvs. spatulate or obovate, obtuse or retuse, not rugose, scarcely 1 in. long; bracts obovate, ciliate, purple-tinged: corolla ½in. long, rarely slightly longer, pale blue. Wash. to Ariz. B.R. 1469. N. TAYLOR.

439. Aucuba japonica var. variegata. (×⅓)

AURÍCULA (*Primula Auricula*, Linn.). Fig. 440. A European perennial, sending up short scapes, bearing flowers of many colors. It is one of the most famous of florists' flowers, but it has never received the attention in this country that it has in Europe. Our summers are generally too hot for it. In this country generally treated as a greenhouse plant; but it is hardy, and in the Old World is grown largely in frames. See *Primula*.

Auriculas grow wild in the mountainous districts of Switzerland, Austria, Syria, and the Caucasus; therefore they are generally regarded as alpine plants, but like many other alpines, they have proved to be excellent subjects for cool greenhouse culture as well as for rock- or alpine-garden culture. In their native habitats, some plants are heavily powdered with a fine mealy substance called "farina," while others are perfectly destitute of it. Under cultivation, also, they show this same characteristic. This has caused fanciers to divide them into two sections; those covered with farina, called show auriculas, and those destitute of it, termed alpine auriculas. The show auriculas have received the most attention at the hands of fanciers. Their flowers are large, and present more combinations in variety of color than the alpine section, and since rains mar their beautiful farina-covered leaves and flowers, they are by far best adapted to greenhouse culture. Like all primulas, the flowers are tubular and borne in erect trusses well above the foliage. Well-grown plants will produce strong trusses with often as many as twenty "pips" or individual flowers. Such a number cannot fully develop, consequently they should be thinned out and only eight or nine flowers allowed to develop on each truss. The tube of the flowers of show auriculas is usually white, with a circle of maroon, violet, plum or chocolate-color above and a margin of green, gray, white, or yellow. In what are called "selfs," the circle of chocolate-maroon, or violet, extends to the edges of the flowers. They are usually very sweet-scented. Alpine auriculas are best adapted for growing in the rock- or alpine-garden since the leaves and flowers are destitute of farina. This section does not exhibit as large a variety of color in the flowers. The tube of the corolla is usually yellow or cream-color with a margin of maroon or purple which shades off toward the edges. The culture given below is the same for both sections except that the alpine section should be planted on the north side of the rock-garden in October, where they will flower the following spring.

Auriculas may be propagated by seed for general purposes and for the production of new varieties, but to perpetuate very choice varieties it is necessary to propagate either by offsets or division of the plants. Seed should be sown in shallow pans or 4-inch pots early in March, so that the seedlings will be well developed before very warm weather sets in. The soil used in the seed-pans should be very light and sandy, the surface should be made smooth, and the seeds then pressed lightly into the soil, after which a light covering of sand should be given, and the pans placed in a temperature of 60° until they have germinated, which usually takes from three to four weeks; pans should then be removed to a light position, shaded from direct sunlight, in a rather lower temperature, to induce a stocky growth. As soon as the seedlings are large enough to handle conveniently, they should be pricked off into other pans or shallow boxes containing a mixture of three parts leaf-mold and one part sifted loam and clean silver-sand. Watering should be carefully attended to, and everything done to promote active growth, so that, if possible, the plants may be large enough to require a second shift into other boxes, similarly prepared, by the end of June. Auricula seedlings go through the hottest months much better in boxes than in pots, as they can be kept more evenly moist. For their summer quarters, a wooden frame placed on sifted coal-ashes on the north side of a building or wall, or almost any position in which they will be sheltered from the sun and still receive plenty of light, should be given them. The frame should be provided with sash, which should be kept over the plants most of the time, giving air in abundance in favorable weather, and during the warmest weather the whole frame should be raised by placing a brick under each corner, so as to allow a good circulaton of air among the plants. About the second week in September the young plants should be potted, using a compost of two parts good fibrous loam, one part leaf-mold, and one part well decayed cow- or sheep-manure, with a little sand added. The frame should be kept a little close for a few days after potting, and from this time care must be taken not to wet the foliage in watering. The plants may remain in the frame until danger of freezing, when they should be transferred to a cool

greenhouse for the winter. All decaying leaves should be carefully removed, and but little water will be required during the dull winter months. Toward the end of February the plants will show signs of flowering, when they should be given a top-dressing of pulverized sheep-manure and placed in a light, airy position, in a temperature of 55°. The flowering season lasts about two months, after which the plants should receive their annual potting. All diseased or decayed roots should be cut away, and most of the old soil carefully removed. The propagation of very choice varieties by offsets or division is best done at this time. The pots used in potting should be well drained, and no larger than will just accommodate the plants. The soil best suited is the same as before recommended. After potting, they may be placed in their summer quarters. Offsets should be inserted around the edge of 4-inch pots, using very sandy soil, and kept in a moist, shaded position until rooted. By annually repotting and giving a little extra care during the summer months, a batch of show auriculas will return very satisfactory results, and may be kept in a good, healthy condition for several years.

EDWARD J. CANNING.

440. Auricula. (×⅓)

AUTUMN COLORS, PHYSIOLOGY OF. When the conditions in almost any locality are favorable for the rapid growth of plants, the prevailing color of the vegetation is green. The leaf-green, or chlorophyll, is a conspicuous part of vegetative organs. Green is normal, so that one does not regard a green plant as "colored." It is true that in some species of plants, chlorophyll is partially or completely veiled by the presence of other pigments, and in the blossoms it may practically fail; but in the latter case the life of the brilliant structures is fleeting, and green is promptly predominant. "Color" is more or less restricted to blossoms, to particular species, or to seasons. The great seasonal change is here the center of interest.

In the autumn the vegetation of the usual temperate landscape loses gradually its distinctive green, while striking yellows and reds are substituted. With favorable conditions, the climax of this transformation is such a riot of color as is not seen at any other time. It is noteworthy that this change is an immediate forerunner of leaf-fall and death. The vegetation that is suddenly cut off by severe frost seldom exhibits true autumnal colors, but instead the dry brown or blackened effects of rapid death, characteristic of any season. On the other hand, autumn tints of leaves may appear in the summer, as when limbs of the hard maple or peach are ringed. This suggests that the production of color is susceptible of experimental study. On the whole, the layman may regard the autumn colors as a necessity to the wholesome rounding out, and a fitting terminus, of a season of usefulness. Coloration is, however, an evidence of fundamental physiological changes; and it is appropriate to ask regarding the climatic or other conditions which bring this about, as well as concerning the nature of these internal changes which also make for the development of color in the autumn.

For the most part, the autumn leaf-colors fall into two groups—yellows and reds. These colors are produced by two groups of pigments essentially different in chemical and physical properties; yet these pigments are frequently blended in the same leaf, yielding such gorgeous effects as may be seen in the sumach.

The yellow pigment (more correctly pigments) of leaves occurs in the chlorophyll bodies of the cell. It is present in conjunction with the leaf-green in the healthy leaf, but not infrequently it seems to increase in quantity as the chlorophyll disappears. It belongs to a group of substances often called xanthophylls. These are carotin-like compounds, that is, related to carotin, the orange or orange-red pigment of the carrot root. Carotin-like bodies are widely distributed in plants and are also responsible for the yellow, orange, and orange-red colors of a large number of blossoms. These pigments do not occur in solution in the cell-sap, but may be present either in the healthy chlorophyll bodies (plastids) or outside of them. In the latter case, they form crystals, or are in solution in droplets of fatty oils. Carotin-like compounds are more permanent than chlorophyll, so that any green plant may exhibit a yellowish color upon the gradual disappearance of the chlorophyll.

The red pigments of autumn leaves are cell-sap colors, substances soluble in the aqueous solution constituting plant juices. They are supposed to be tannoid compounds, and are generally referred to as anthocyanin. The pigments of red beets and dark grapes are similar compounds. It is significant that those plants exhibiting conspicuous red coloration in the autumn are usually those which give some indication of red during the growing season, as in the possession of red petioles or twigs; and, more especially, they are those in which red is more or less conspicuous as the buds open and the leaves unfold in the spring. The attractive tints of unfolding hard maple buds are therefore an indication that the maple has the capacity to develop a coloration of the cell-sap in the autumn. Some plants develop no anthocyanin under normal conditions of growth.

It is then evident that the yellow colors of autumn leaves may be due to both a greater visibility of the yellow in the chlorophyll body when the chlorophyll disappears, and also to actual increased development of carotin-like compounds. The reds and purples in autumn leaves are a result of the formation or increased formation of tannoid compounds. The question then is: What are the conditions which make the autumn season particularly favorable for the development of these substances?

Some careful studies have been made that bear upon this question. It appears that the production of autumnal reds in many species is related to the sugar-content, and color may be induced or heightened in the shoots of many plants by growing them for a time in strong solutions. Moreover, cold weather has been found to be generally favorable to the accumulation of sugar in the tissues. Observation indicates that after a season favorable for growth, a cold, protracted autumn results in exquisite autumn coloration. It is certain that nothing is more disastrous to brilliance of color than severe early frosts. In addition to enhancing pigmentation, sugar-content seems to be most important as one factor in cold-resistance. It requires a very light frost in the late summer to kill outright the leaves and young shoots of many trees, but the same shoots may be unaffected by an equal degree of cold when the conditions have been such as to bring about the normal autumn coloration.

B. M. DUGGAR.

AUTUMN-GARDENING. There is wealth of material for spring-and summer-gardening; but to secure good garden effects in autumn requires mostly other material and a different intellectual conception of the problem. The common problems of the gardener in autumn grow out of two facts: First, the frost kills tender plants sooner than he desires; therefore he tries

to save vegetables and flowers as long as possible by protection and by choosing hardy kinds. Second, gardens tend to look unattractive and seedy in September, because this is nature's time for ripening fruits; therefore he desires fresh flowers. The popular demand is for fresh vegetables as long as possible, color in the garden right into the teeth of winter, cut-flowers after frost, home grounds that will be attractive even after a summer's absence, and a note of welcome to the children in every school-yard. Also, there are enthusiasts who wish gardens devoted exclusively to autumn beauties.

Prolonging the vegetable-garden.

The ideal way to prolong the yield of fresh vegetables in late autumn is by means of greenhouse, hotbeds and coldframes. In frames, which are the cheapest, it is

441. A good autumn landscape for color effects.

easy to have in November lettuce, spinach and radishes. The next best plan is to shelter the garden from cutting winds and frost by a windbreak, e.g., wall, fence, hedge, natural wood, or group of evergreens. Sheltered gardens often yield fresh vegetables two to six weeks after adjacent unsheltered gardens have been devastated by frost. It is also possible to prolong the season by raising late-growing varieties and by starting the ordinary kinds later in the year.

Freshening the flower-garden.

Parks and the grounds of wealthy people often rely chiefly on tender or temporary bedding plants, e.g., cannas, dahlias, scarlet sage, gladioli, geraniums and Pfitzer's torch-lily, for their largest masses of autumn color. This method gives the greatest show the first year, but is costly in the long run. Moreover, these plants are killed by frost, leaving gaps too large to fill.

A grade higher is hardy bedding, which has become popular since 1900. The favorite plants are long-blooming shrubs and perennials, e.g., Baby Rambler rose, garden and tree hydrangeas, Miss Lingard phlox, gaillardias, stokesia, Napoleon III pink, double ragged robin, *Veronica longifolia* var. *subsessilis*, *Conoclinium* (*Eupatorium*) *cælestinum*.

Unfortunately, the flowers of the two preceding lists do not really freshen the garden, because they are summer flowers or are being made so by the irresistible tendency to exploit earlier varieties of everything. As taste improves, there is a reaction against excessive use of long-blooming plants, and a desire has arisen for "season markers." Among the finer plants of this real autumn sort are *Colchicum Parkinsonii*, *Crocus zonatus*, *C. speciosus*, *C. sativus*, *Crinum Powellii*, *Sternbergia lutea*, *Chrysanthemum uliginosum*, gordonia, and the rarer plants to be mentioned hereafter. They are, however, plants of the skilled amateur.

For beginners, the favorite hardy autumn flowers include the following annuals or plants treated as such, —China asters, pansies (sown outdoors about May 10 in latitude of New York City), snapdragons, and cosmos; bulbs,—*Colchicum autumnale;* perennials,—sneezeweed, *Helianthus orgyalis* and *H. Maximilianii*, and pompon chrysanthemums.

Another way of providing fresh color in autumn is to make a second or June sowing of favorite annual flowers, e.g., sweet alyssum, candytuft, love-in-a-mist, common and pot-marigold, mignonette, nasturtium, phlox, California poppy, portulaca and zinnia. These usually fail in September from the April sowing. The June sowing will carry them beyond a hard frost, except nasturtium and portulaca.

Flowers after frost.

In early November, after frost had devastated the gardens in the neighborhood of Philadelphia, the following flowers were in condition at one of the largest nurseries of perennials. Only those are mentioned that gave decided masses, not mere dots or remnants of color: *Aconitum columbianum*, *A. Fischeri*, alyssum, antirrhinum, *Aster grandiflorus*, *A. tataricus*, *Cimicifuga simplex*, Napoleon III dianthus, *Erigeron glabellus*, gaillardias, gladioli, *Helianthus Maximilianii*, hunnemannia, kniphofias, pansies (sown in May), Miss Lingard phlox.

Nearly all the flowers in the two preceding lists are available for home decoration, although the quality may not be equal to that of early September. If long-stemmed, long-lasting flowers are needed in quantity, the most satisfactory, perhaps, are chrysanthemums, snapdragons, Miss Lingard phlox, gaillardias. To this list may be added delphiniums, Baby Rambler rose and *Catananche cærulea*.

Gardens based on the dominant color.

It is feasible to make a garden that changes its color every three or four weeks, based upon the idea that a garden may well reflect the dominant color in the landscape produced by the wild flowers of each season. Since yellow is the dominant color of autumn (witness the goldenrods, sunflowers and other composites) such gardens may be rich in sneezeweed and perennial sunflowers (especially *Helianthus Maximilianii*, *H. orgyalis*, and *H. multiflorus* var. *plenus*) since these are particularly appropriate to season and country. The following yellow flowers of summer may be prolonged into autumn by seed-picking, cutting back, fertilizing, and watering: Tufted pansies, snapdragons, Golden Glow rudbeckia, gaillardia, Iceland and horned poppies, *Anthemis tinctoria* and *Lepachys columnaris*.

Gardens of perennial asters.

The English make an exceedingly showy, yet artistic, garden based upon what they call "Michælmas daisies" (asters), of which 137 species and varieties are catalogued by a single dealer. It consists of a double border devoted to the early kinds that bloom during the first three weeks of September; and a separate border for the October- and November-blooming species.

The pictorial effect is improved by a definite color scheme, planting in drifts, and an ingenious system of training on hidden branches. This type of garden is of peculiar interest to Americans because the perennial asters are mostly American wild flowers, and it meets the general desire to grow a class of flowers which is too prolific for the ordinary garden. Owing to the notorious difficulties of identifying species of this genus, Americans find it more practicable to import collections than to assemble species from the wild. The true asters are generally supplemented by yellow flowers of other genera (e.g., Chrysopsis) in order to make the early garden a pink and yellow composition, while the later garden is devoted to purple, lavender and blue.

Woody plants for autumn bloom.

In larger gardens and on home grounds it is desirable to secure flowers by using more permanent materials, as woody plants. Unfortunately, the only tree that blooms in autumn (gordonia) has to be wrapped during winter in the North. The list of vines also is small, being confined to left-over blooms of trumpet creeper, Hall's honeysuckle, and panicled clematis.

The autumn-blooming shrubs, however, are excellent. Unluckily, the showiest of them all, *Hydrangea paniculata* var. *grandiflora*, is commonly used in such ways as to bring upon American yards the reproach of gaudiness and vulgarity. It looks gross and over-fed compared with the slender grace of its prototype, *H. paniculata*, and its double flowers are artificial compared with the single ones. True, they last longer and give more for the money than any other flower of autumn, but such plants from their irresistible appeal to beginners, are planted in every yard and tend to make home grounds look too much alike and too common. The situation is aggravated by inartistic ways of using it, e.g., hedges from sidewalk to porch, great masses across the front of the house, borders of curving drives, and beds in the middle of the lawn. Again, it is pruned severely to make the largest trusses, which results in loss of height and dignity, and in top-heavy masses ill-concealed by supports. A better system of yard-decoration, is the use of informal shrubbery borders, since they give year-round interest and greater variety to yards.

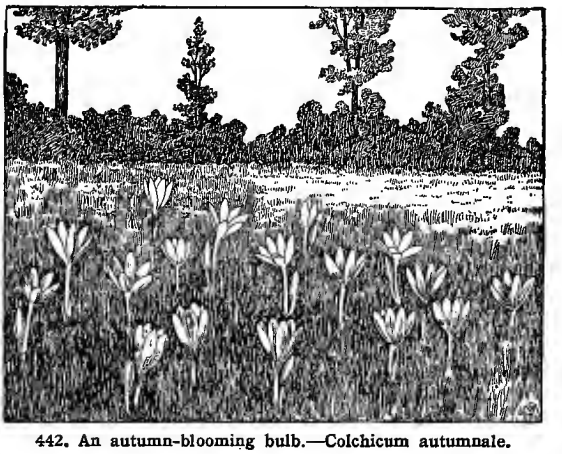
To supplement the ubiquitous double hydrangea, the following may be recommended, subject to the limitations noted: *Abelia chinensis*, white, begins blooming in Georgia in June and is well covered in New England as late as September 30; *Abelia grandiflora*, pink, needs a winter covering of boughs North; *Baccharis halimifolia*, has tufts of showy pappus, like camel's-hair brushes, that look like white flowers; *Buddleia variabilis*, pink, is killed to the ground at New York but recovers and blooms freely; *Caryopteris Mastacanthus*, blue, behaves like buddleia; *Hamamelis virginiana*, yellow, not showy, but the last shrub to bloom; *Hibiscus syriacus* or althæa (only the single white variety here recommended); *Hydrangea paniculata* var. *tardiva*, which gives a fresh white after the double hydrangea has begun to assume its metallic colors; roses, hybrid teas, which are at their best on Long Island in early September; *Vitex Agnus-Castus*, lilac, hardy to New York.

A more artistic way of securing color.

Although the popular interest is in flowers, there is a far more important method of securing color,—by means of trees, shrubs and vines with brilliant autumn colors in foliage and fruit. This method is more artistic because more appropriate to the season, more permanent, and cheaper in the end. It is also more American, because we have more native shrubs than autumn flowers; because shrubbery is the only class of material (except water-lilies) in which we enjoy a climatic advantage over England; and because autumnal colors in America are more brilliant than those in western Europe.

For home decoration, cut sprays of multiflora rose, common barberry, bittersweet, and the like, are longer-stemmed and last longer than flowers. Those just named remain attractive all winter, even when shriveled.

Our climate naturally suggests flowers in spring, attractive foliage in summer, natural colors in autumn, and in winter the shrubs with brightly colored berries and twigs. The late season situation can be met by making 90 per cent of the planting consist of combinations of trees and shrubs with triple or quadruple attractions of flowers, foliage, autumn colors and fruit, e.g., *Cornus alba* and var. *sibirica*, *C. Amomum*, *C. florida*, and *C. mas*; *Viburnum cassinoides*, *V. Lentago*, *V. prunifolium*, *V. Lantana*, *V. tomentosum*, and *V. americanum*; *Magnolia stellata*, *M. Soulangeana*, *M. glauca*, *M. acuminata*, and *M. tripetala*; *Berberis vulgaris* and *B. Thunbergii*; Regel's privet and the best form of the Amoor River privet; Morrow's bush honeysuckle; prairie, multiflora, rugosa, and Wichuraiana roses and their sturdiest descendants; and the following vines: *Euonymus radicans* var. *vegetus*, trumpet creeper, wistaria, bittersweet, and the wild and panicled clematis.



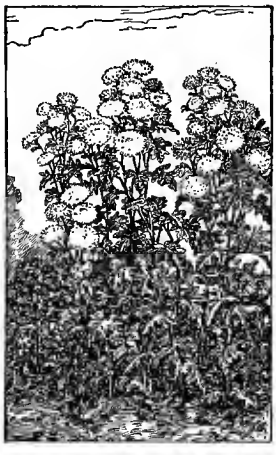
442. An autumn-blooming bulb.—Colchicum autumnale.

Color harmony in autumn.

Sentimentalists aver that nature never produces discordant colors, although the famous poinciana of the tropics and the nemesias of the garden furnish a combination of magenta and scarlet in the same flower. A walk through a good arboretum in September will convince the unprejudiced observer that discords exist in flowers, fruit, and foliage. In practice, nine-tenths of the troublesome discords are produced by the magenta group of colors, including the strongest purples, crimson, lilac, and crimson-pink. The artistic way to handle these colors is to isolate them in nooks surrounded by green, or to put them in deep shade, where they are purified and softened, instead of allowing them in the open garden, where full sun makes them too strong and where they conflict with all other colors, except white and green. The list of "dangerous colors" includes the flowers of Japanese anemone, crimson-pink chrysanthemums and China asters (in all of which safer colors are available), the Anthony Waterer spirea, the subsessile veronica, *Lespedeza Sieboldii* and *Clerodendron fœtidum*. Examples among fruits are Indian currant, callicarpa, burning-bush, strawberry-bush and several of the species of euonymus during the period when their highly colored capsules conflict with their scarlet arils. The purplish-twigged shrubs, e. g., *Cornus alba*, *C. Amomum*, *C. stolonifera*, and *C. Purpusii* (the last a species commonly but unwittingly distributed as *C. Amomum*), constitute an exception, since they are brilliant only in sunlight, and their color being dis-

sipated, instead of massed, is less liable to produce discords.

In foliage, the colors bordering on magenta are so rare that they may be ignored in planning the home-grounds, although careful designers always consider autumnal colors. When discords occur they may be resolved usually by planting between the discordant trees or shrubs some plants that retain green foliage until late autumn. Wine- or claret-colored foliage, like that of the maple-leaved arrow-wood, or crimson, like that of *Itea virginica*, occasionally makes discords with nearby foliage of yellow or scarlet, but in the case of such small plants it is usually easier to remove one of the trouble-makers. The sweet-gum, however, often makes a large mass of very dark purple, which may seriously disagree with yellow-foliaged specimens, or with buildings of yellow or red, especially since it has come to be used as a street tree. In practice, however, flowers make less trouble than shrubs, and shrubs than trees, and discords may generally be abolished by moving the smaller plants. The commonest and greatest color difficulty in autumn foliage comes from over-planting the following class.



443. Hardy chrysanthemum, one of the best of the autumn-blooming herbaceous plants.

Scarlet foliage in autumn theoretically may be no more vivid than other colors, but it is popularly regarded as the climax of all the autumn colors. For example, persons who give little thought to planting for autumn effect buy the scarlet and Tartarian maples, the red variety of silver maple, and ask the nurserymen for "a sugar maple that is guaranteed to turn red." The aromatic, scarlet, smooth, and staghorn sumachs are in considerable demand. And, above all, the Japanese and common barberry are planted. At the entrance to public parks are often seen several hundred Japanese barberries planted in a bed for a blaze of autumn color. If disproportionately large, such masses of scarlet are perhaps only one grade higher than tender foliage plants. The brilliant reds commonly conflict with brick buildings and parti-colored houses of wood.

Deep red foliage in autumn is quieter, but rich enough. It is seen in the scarlet, pin, and red oaks, flowering dogwood, black choke-cherry, wild gooseberry (*Ribes Cynosbati*), and several native huckleberries and roses.

Bronze foliage is seen in most of the plants that become red, for they attain to it from green through many bronzy colors. But the richest bronzes generally are associated with thick, lustrous, persistent leaves. The most highly esteemed, because most costly, are the broad-leaved evergreens, e.g., the Hinodigiri and amœna azaleas, mahonias, leucothoës, *Pieris floribunda* and *P. japonica*, and galax. These assume their brightest colors in full sunshine and, at the northern limits of their cultivation, sometimes suffer a loss of foliage. In the higher latitudes it is often best to sacrifice color to hardiness, by sheltering the plants from winter winds and sunshine, in which case they usually retain a lively green. A cheaper list, because composed of semi-evergreen plants, comprises California privet, Hall's honeysuckle, Wichuraiana rose, sweet fern, and bayberry. These color poorly in some localities, but they are of special value in the latter half of November, when the landscape first becomes bare, except for evergreen and nearly evergreen plants.

Yellow and orange foliage in autumn is midway between the vivider and the quieter autumn colors, the former having an exciting, while the latter have a soothing, effect upon the mind. The yellow and orange group rises in vividness from pale yellow, through gold to orange, the three stages being exemplified by larch, witch-hazel, and persimmon. Here belong the striped maple, yellow-wood, Kentucky coffee tree, ironwood, *Prunus pennsylvanica* and *P. serotina*, cucumber tree, large-leaved magnolia, *Cratægus punctata*, yellow-root and sugar maple. The duller yellows merge with the next group.

Brown and neutral autumn foliage tones down the most brilliant colors and resolves nature's discords. Examples are the American and slippery elms, and perhaps even the brighter red and chestnut oaks.

Green foliage in autumn is even more valuable in harmonizing colors. It is well expressed in the evergreens and nearly evergreen plants. The sudden devastation of the landscape occasioned by the fall of the leaves (whence the Americanism "fall" as a synonym of autumn) excites fresh interest in all the plants that remain green. These are of three classes: (1) The *broad-leaved evergreens* constitute the most sumptuous class of hardy plants, because they often possess showy flowers or fruits in addition to broader and more lustrous leaves than the conifers. Of the fifty kinds that are hardy in the latitude of New York, the following have special autumn attractions: *Osmanthus Aquifolium* (flowers), mountain laurel (red twigs), American holly, climbing euonymus, fire thorn, *Cotoneaster buxifolia* and *C. microphylla*, partridge berry, and wintergreen. In the South, the following have special attractions in autumn: English holly, *Euonymus japonicus*, ardisia, and nandina, all of which have red fruits, and pernettyas having fruits of various colors. Unfortunately, no plant of this class much exceeds 15 feet in height in the northeastern United States, and it is idle to hope for a 50-foot tree of this group, such as England possesses in the holm oak or ilex. (2) The *narrow-leaved evergreens*, or *conifers*, may lack showy flowers but they furnish more tall hardy plants than the broad-leaved evergreens. Their year-round uses are too numerous for mention here, but their autumnal functions are four,—(*a*) to harmonize discords; (*b*) to rest the eye from color; (*c*) to furnish contrast, which intensifies color; (*d*) to give greater dignity than showy colors possess. This dignity is due to the year-round beauty, longer life, and costliness of white and red pine, northern and Carolina hemlock, Nordmann and concolor fir, white and Douglas spruce, red cedar and arborvitæ, as compared with cheap, showy and temporary deciduous trees like willows, poplars, silver maples, and the like. Even the Vermont sugar-bush which, in October, is one of the most gorgeous spectacles, presents a finer appearance in the landscape when skirted by occasional white pines, which add greatly to the dignity and "paintable quality" without obscuring its farm value or purposeful character. (3) The *nearly evergreen* or *half-evergreen plants* may be bare from one to three months, depending largely on latitude and season. The plants that remain green until their leaves fall are mostly natives to western Europe, or to the warmer parts of China, Japan or Korea, and are usually associated with a moist and cloudy autumn. European examples are buckthorn, common privet, sea buckthorn, *Cytisus capitatus* and *C. nigricans*, *Genista tinctoria*, *G. elata*, *G. pilosa* and *G. germanica*. Far-eastern examples are California privet, matrimony vine, panicled clematis, *Akebia quinata* and *A. lobata*, *Lonicera fragrantissima* and *L. Standishii*, and *Euonymus Hamiltonianus* var. *semipersistens*. American examples are few, and *Lonicera Ledebourii* comes from California (climate like Europe), but the overcup oak and *Leucothoë racemosa*

are eastern and southern plants. All these species were reported as being green at the Arnold Arboretum as late as November 8. The peculiar value of this class is as a substitute for broad-leaved evergreens. Unfortunately, the climate of the northeastern United States is not favorable to broad-leaved evergreens, compared with the South or Europe, and the lavish use of them requires a princely income. Consequently, some of these cheaper plants, e.g., California privet, Hall's honeysuckle, and Wichuraiana roses, are available even to the poor, while the whole list is of special interest to people who have summer homes.

Ornamental fruits of autumn.

The extraordinary beauty of shrubs with brightly colored berries was first publicly and sufficiently demonstrated in this country by the Arnold Arboretum. Compared with autumnal colors of foliage, the fruits present fewer, smaller, and more jewel-like masses. Amid the bewildering variety one may discern three groups.

First are the short-lived fruits, which drop soon after the killing frost, or present an unattractive appearance owing to decay. Here belong the vast majority of ornamental fruits, including crab apples, dozens of hawthorns, *Viburnum Lantana, V. alnifolium, V. cassinoides, V. Sieboldii*. The chief function of this class is to suggest the fecundity and variety of nature in autumn, but attractive thorneries have been designed, and the ornamental fruits of the Rosaceæ are now used to connect the battle-scarred remnants of old orchards with modern ornamental planting, especially boundaries.

The second group comprises all the fruits that remain attractive until Christmas, e.g., the rugosa rose.

The third and most valuable group comprises those that remain attractive all winter, like the barberries. This and the second group are classified by color under *Winter Gardening* (Vol. VI.)

Most persons are willing to sacrifice some degree of ornament in order to attract the birds. The following furnish food in autumn, when it is especially desirable to attract the migrants to the South: the flowering dogwood, red osier, and alternate-leaved dogwood, choke-cherry, black and sweet elder, arrow-wood, sassafras, kinnikinnick, crab-apple, hawthorn, firethorn, cotoneaster, buffalo berry, tupelo, and mountain ash.

Landscape forestry in autumn.

Private and public woodlands in the East are more beautiful than a decade ago, in spite of the destruction of magnificent chestnut trees, and this is true, although probably to a lesser extent, in other parts of the country. The sudden spread of the chestnut disease has brought certain compensations. For example, the flowering dogwood, which was formerly kept down, has prospered mightily, making the woods showier both in May and September; and other vegetation changes are following.

There is arising a general interest in pleasure woods, as witness the term "landscape forestry," which was unknown ten years ago. We are beginning to make personal use of woods. Judged by English standards, American woods are too crowded by crooked and spindling trees for comfort, and the general lack of evergreens robs them of mystery and charm. Our most urgent needs, therefore, are thinning, drives, paths, and the restoration of evergreens, all of which are especially enjoyable during the autumn and nutting season. Mistaken zeal has denuded many woods of undergrowth, which should quickly be restored along drives and paths. To glorify the woods on dark autumnal days, it is well to use masses of witch hazel, the foliage of which furnishes one of the cheapest and quickest ways of getting great sheets of sunny color.

Unfortunately the eastern mountains have been devastated so often by fires and lumbermen that there is comparatively little variety, the chief masses of color being furnished by quick, short-lived species, like poplars, birch and balsam, which are mere weeds compared with the more enduring and valuable oaks and pines. Our greatest problems are the restoration of variety and of long-lived species. In such work the fashionable colonies in the Berkshires ought to take the lead, since the social season reaches its height at Lenox in September. The Arnold Arboretum presents one of the most artistic, and probably the most varied, autumn landscapes made by man.

WILHELM MILLER.

AVÈNA (the old Latin name). *Gramineæ*. OATS. Mostly annuals with open panicle and large spikelets. Spikelets 2-6-fld.; rachilla bearded below the florets; glumes about equal, large and membranaceous, many-nerved, usually as long as the spikelet; lemmas indurated, bidentate at apex, bearing a stout twisted awn on the back (this often straight or wanting in the cultivated oat).—Species about 50, of the temperate or cooler regions of the world. Scarcely grown as ornamental subjects.

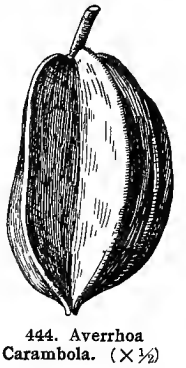
fátua, Linn. WILD OATS. Resembles the cultivated oat, but differs in having long, brown hairs on the lemmas: spikelets usually 3-fld.; glumes 1 in. long; awns of lemmas about an inch long. Dept. Agric., Div. of Agrost. 20:94.—Intro. from Eu., especially on the Pacific coast, where it is a troublesome weed. In the latter region the spontaneous growth is frequently used for hay.

satîva, Linn. CULTIVATED OATS. Spikelets usually 2-fld.; lemmas glabrous, awns usually straight or wanting. See Cyclo. Agric. I.

stérilis, Linn. ANIMATED OATS. Resembles *A. fatua* but the spikelets larger, the glumes about 1½ in.; awns 2-3 in.—Occasionally cult. as a curiosity, the florets when moistened presenting spontaneous movements due to the twisting and untwisting of the awns as they absorb or give off moisture.

A. elàtior=Arrhenatherum elatius.

A. S. HITCHCOCK.



444. Averrhoa Carambola. (×½)

AVERRHÒA (after Averrhoes, the Arabian physician). *Oxalidàceæ*. Tropical fruit trees, cultivated in India and China, and sometimes grown under glass for ornament.

Leaves alternate, odd-pinnate; lfts. alternate, ovate-acuminate, entire, stalked, sensitive: fls. borne on the naked sts. and branches, minute, fragrant, rose-colored to reddish purple in axillary or lateral cymes which are often panicle-like; calyx red; corolla campanulate; petals 5. See N. Amer. Fl. 25:57 (1907).

Carambòla, Linn. CARAMBOLA. Fig. 444. Height 15–30 ft.: lfts. 5–10: fls. rosy purple borne in the lf.-axils: fr. varying in size from a hen's egg to a large orange, ovate, acutely 5-angled, yellow, fragrant, the pulp acid. P.M. 15, p. 231. Rheede, Hort. Ural. 3. pl. 43, 44. Cav. Diss. pl. 202.—Cult. sparingly in S. Calif., and frequent in W. Indies. The half-grown fr. used as pickles; the ripe fr. for preserves. There are said to be two varieties, the sweet and sour, the former being eaten. Said to produce 3 crops a year. Leaves responding to the touch.

A. Bilimbi, Linn. CUCUMBER TREE. BILIMBI. Height 20–60 ft.: lfts. usually 31–45 pairs: fls. red, in longer clusters than the above and borne on branchlets from the hard wood: fr. smaller than the carambola, cucumber-shaped, smooth, green rind, and acid pulp. Extensively cult. in S. Amer. P.M. 15, p. 231. Rheede, Hort. Mal. 3, pl. 45:46. Lam. Encyc. pl. 385.

N. TAYLOR.†

AVICÉNNIA (from *Avicenna*, the Latin name of an illustrious physician of the Orient, 980–1036). *Verbenàceæ*. Black Mangrove. White Mangrove. Trees or shrubs usually growing in mangrove swamps and on the shores of tropical estuaries, remarkable for the vertical leafless breathing-stems that rise above the soil from their long spreading horizontal roots.

Leaves opposite, entire, coriaceous, persistent: fls. small and inconspicuous in axillary cymes; calyx cup-shaped, deeply 5-lobed; corolla bell-shaped, whitish, 4-lobed; stamens 4, inserted on the corolla-tube, exserted, bearing ovate, 2-celled anthers; ovary sessile, 1-celled, ovate, tapering upward into a slender 2-lobed style, and containing 4 ovules suspended from a central placenta: fr. ovate, oblique, opening by the ventral suture and exposing the expanding embryo, before dropping off; embryo with broad, fleshy conduplicate cotyledons.—Three species now recognized: *A. nitida* which reaches S. Fla. and La., *A. officinalis* of Polynesia and the E. Indies, and *A. africana* of the west coast of Afr. Planted on the shores of estuaries to prevent washing by tidal currents, they collect floating debris by means of their erect breathing-sts., and by this means aid in extending the shoreline seaward.

nítida, Jacq. Black Mangrove. White Mangrove. Honey Mangrove. Salt-Bush. A tree, usually of moderate size but sometimes 60 to 70 ft. high, with a short trunk, and spreading crooked branches: inner bark bright orange-red, outer bark scaly, deciduous, dark reddish brown: young branches hoary-pubescent, at length glabrous and marked with interpetiolar lines and conspicuous lf.-scars: lvs. opposite, oblong or lanceolate-elliptical, gradually narrowed at the base, coriaceous, deep green and glossy above, whitish or grayish beneath, 2 or 3 in. long and about 1–1½ in. broad: fls. inconspicuous, fragrant, borne in few-fld. spikes on angled canescent peduncles, closely invested with small bracts; corolla whitish, about ½in. diam. when expanded, the lobes slightly tomentose on both surfaces, and the 4 anthers together with the style protruding from the nearly closed throat: fr. oblong or elliptic 1–2 in. long and about 1 in. broad. Mangrove swamps and shores of estuaries, Fla., Miss., and Texas; also Trop. Amer.—The fls. are very rich in honey, on which account bee-keepers in certain parts of Fla. transport their entire apiaries to the coast, along the Indian River during the season of blooming, which occurs in June and July. The honey produced is white and clear, and of excellent flavor, and always commands the highest market-price. The embryo begins to germinate while the fr. is still on the tree. When it drops off, the two cotyledons unfold into a miniature boat, floating on the tide, which distributes the fr. along the shores of bays and lagoons and carries it to the outlying keys. Crystals of salt are often deposited on the lvs., on which account this species is sometimes called *palo de sal*, or salt-bush. W. E. Safford.

AVOCADO. (*Persèa gratíssima*, Gaertn.). Figs. 445, 446. One of the most highly valued of tropical fruits. It is commonly grown in Mexico, Central America, parts of South America, the West Indies, and Hawaii; to a limited extent in India, Madagascar, Reunion, Madeira, Samoa, Tahiti, Algeria, Queensland, and other tropical and subtropical countries. In Florida and California, its cultivation is conducted commercially. See *Persea*.

The avocado is considered by most authorities to be indigenous to Mexico, Central America, and South America to Peru and Brazil. From the Aztec *ahuacatl* has been derived the Spanish adaptation *ahuacate* or *aguacate*, the name in general use in Spanish-speaking countries. *Avocado* is an adaptation in use in the United States and other English-speaking countries; *avocat* in the French colonies. *Alligator pear* is a misleading corruption that should be dropped.

Seedling avocados grow to a height of 50 or 60 feet; when budded the tree is considerably dwarfed. The leaves are elliptical to oblong-lanceolate, varying from 4 to 8 inches in length, persistent, deep green, the new growth frequently wine-colored. The tree is worthy of a place in every dooryard for shade and ornament. The small, greenish flowers are produced in great abundance on loose axillary racemes.

The fruit is variable in form, color, and size, as well as in quality and minor characters. The form ranges from oblate or spherical to slender pyriform, including a great variety of shapes, one of the commonest being broad pyriform. The color may be light or dark green, purple, crimson, or maroon. The fruit varies from 1 to 6 inches in diameter, and in weight from a few ounces to three or four pounds. The skin is sometimes soft and pliable, and no thicker than that of an apple;

445. Avocado tree.

in other forms it is coarsely granular, woody, and ⅛ inch thick,—in reality almost a shell. Inclosed by it is a mass of yellowish pulp, of the consistency of firm butter, and of delicious nutty flavor. The avocado is unlike most other cultivated fruits in the fact that it contains a large amount of vegetable oil, sometimes as much as 18 per cent; hence it can be considered more as a food than as a dessert. It is used in numerous ways, the commonest being as a salad, with the addition of salt, pepper and an acid. Sometimes it is cut in half, the seed removed, and the flesh eaten with a spoon, as muskmelons are eaten, salt or other condiment being added. The single, spherical or conical seed is frequently as large as a hen's egg. It is provided with two more or less distinct coats, which sometimes adhere to the seed, and in other instances to the flesh.

In recent years the avocado has been given systematic attention in the United States, both in regard to cultivation and varieties. Previous to 1900, propagation was exclusively by seed, and as the species is variable when grown in this way, many trees produced inferior

fruit and commercial cultivation on a sound and profitable basis was not possible. The choicest varieties are now propagated by budding and are grown on a large scale.

The diverse climatic conditions under which the avocado is found enable varieties to be obtained which are suited to regions with cool climates as well as those which are strictly tropical. In Mexico the fruit has been grown for centuries at altitudes of 6,000 or 7,000 feet, where severe frosts are experienced each winter; varieties from such regions, as opposed to those from hot and humid lowlands, are suitable for cultivation in those parts of California and Florida in which slight frosts are the usual winter occurrence. When mature, some types will stand temperatures as low as 20° F. without injury, if in proper condition at the time of the freeze; others will not withstand lower than 27° or 28° without serious damage.

The subject of races or types has not been given systematic attention outside of the United States, and no attempt at classification has been made, other than brief descriptions of types found in limited areas in Mexico and Central America. In California two very distinct types are grown, commonly referred to as the Mexican and the Guatemalan; the former (*Persea drymifolia* of some botanists) is ordinarily a small fruit, four to eight ounces in weight, oval or pyriform, and thin-skinned. It is one of the hardiest types in cultivation and very productive, as a rule. The Guatemalan type is characterized by its thick, woody skin, frequently rough or tuberculate on the exterior; the fruits are medium-sized. It is considered one of the best for commercial use, as it can be shipped without difficulty. The type grown in Florida is usually referred to as the West Indian-South American. It has a skin sometimes as thick as the Guatemalan, but of softer texture; some varieties are of large size and attractive appearance, but the type is rather susceptible to frost.

The avocado has been subjected to systematic cultivation for so brief a period that a large number of named varieties has not been established. In Florida the Trapp is the most widely planted and is, in fact, the standard commercial variety, Pollock occupying the place of next importance. Several others are grown to a limited extent, including Family, Rico, Blackman, and Wester. In California some of the most promising varieties are Taft, Lyon, Meserve and Murrieta; a number of others have been disseminated. Several named varieties have been established in Hawaii.

For commercial cultivation, winter-fruiting varieties have been found to be the most valuable, since northern markets are almost destitute of fresh fruit during that season. It is desirable, however, to have a supply, for local consumption at least, during other seasons of the year. Fortunately varieties are obtainable which ripen at widely different times,—in California fruit is in the markets fully ten out of the twelve months, although the season in Florida, at the present time, is not so long. A variety running uniformly about a pound in weight appears to be the most desirable, and if the fruit is round or oval, it can be more advantageously packed and shipped than if pear-shaped or "bottle-necked." The skin should be sufficiently thick and tough to withstand shipment without undue care in packing, and the seed should be as small as possible. It is also important that the seed be tight in its cavity, for in the loose-seeded varieties, the flesh is often seriously damaged by the seed shaking around while the fruit is in transit. Flavor and quality must of course be up to the standard, there being a wide difference among the varieties in these respects.

Large seedling trees of the small-fruited Mexican type sometimes produce as many as 2,000 or 3,000 fruits in a season, while a large-fruited variety may not produce more than a few dozen. Two or three hundred fruits may be considered a good crop for a tree of a medium-sized variety.

In Florida, budded trees are planted in orchard form 20 feet apart; in California the distance is increased to 24 or 25 feet. Seedlings must be given more room,—30 feet at least. A well-drained, sandy loam is the soil best suited to the avocado, drainage being the most important requirement. For this reason it is best, where possible, to select a sloping piece of ground as a site for the orchard. Heavy soils, such as clay and adobe, will grow the tree successfully if the drainage is good.

Transplanting is best done in early spring, after danger of frost is over, but before the tree has started into new growth. In climates such as those of California and Florida, the tree is in a semi-dormant state after the cool weather of winter, and can be moved with little difficulty. A ball of soil should be taken with the roots, and the top pruned moderately. In light soils which cannot be balled, the trees should be transferred to pots or boxes and allowed to establish themselves, after which they may be set out in the orchard without disturbing the roots. When the budded trees have been grown in pots, the possibility of injuring the delicate roots is eliminated.

The cultural requirements of the avocado are similar to those of the citrous fruits. In dry climates the trees must be irrigated regularly and frequently, particularly during the first two or three years. For bearing trees a fertilizer containing 3 per cent nitrogen, 5 per cent phosphoric acid, and 12 per cent potash has been recommended, the quantity required each season varying from three to ten pounds per tree, according to the character of the soil. This should be applied in several doses during the growing season. The growth of young trees is greatly encouraged by organic nitrogen. Leguminous cover-crops are very desirable, for the humus they will furnish as well as the nitrogen.

Often there is a tendency, especially in seedlings, to shoot upward and not spread out; this must be checked by heading back. All weak or unshapely growths should be trimmed out, and all wounds made when pruning should be covered with grafting wax or paint to prevent the entrance of any fungus into the wood. It is well to keep the trees headed low to prevent damage from winds as much as possible; this also brings the fruit within easy reach for picking.

In regions subject to severe frosts, the trees should be protected during the first two or three winters with a shelter of palm leaves, corn stalks, burlap, or some such material. Where irrigation is practised, it is well to harden the trees by withholding water in late fall.

In Florida the avocado is attacked by the wither-tip fungus (*Colletotrichum gleosporioides*), which can be controlled with bordeaux mixture. Two or three scale insects have been noted on trees in California, but up to the present time they are not of serious importance, with the exception of the black scale (*Saissetia oleæ*), which sometimes requires combative measures. The avocado mealy bug (*Pseudococcus nipæ*) is troublesome in Hawaii.

For market purposes, the fruit should be graded according to size, color and form, and carefully packed; it is essential, if the fruit is to be shipped any distance, to select varieties having good carrying qualities. Light wooden crates are used for shipping, containing one layer of fruits, and provided with good ventilation. The fruits must be separately wrapped in pieces of strong paper, and packed closely together to prevent their shaking about and becoming bruised. If they are to be shipped long distances, refrigeration is essential, experiments having shown that the temperature should be 40° to 45° F. Prolonged storage in temperature lower than 40° results in decomposition of the flesh.

Seedlings do not usually bear as early as budded trees, and on account of the variation which they are

likely to show in productiveness, as well as in form, size and quality of fruit, they are unsuitable for commercial cultivation. For the home grounds, on account of their ornamental value, they are worth planting; it is imperative, however, to select seeds from the most desirable fruits, of known quality and productiveness.

The avocado is budded on seedlings of the same species. For nursery purposes the seeds are usually planted singly in pots or in rows in the open ground. They may also be planted in flats, and potted off as soon as they have germinated; as the roots are delicate and easily injured, however, this is not a desirable method. A glasshouse is unnecessary, provided the seeds are planted during warm weather, but they are usually started under a lath or slat covering of some kind. Seeds will not retain their vitality very long, and should be planted as fresh as possible. Pots or boxes less than 4 inches in diameter should not be used. The soil should be light and porous, preferably rich in humus. Most avocado seeds are somewhat conical; they should be planted with the pointed end up, leaving the tip projecting above the surface of the soil. The pots should then be plunged in a frame, covered with straw or litter, and kept continually moist, but not soggy. Germination will take place in two or three weeks if conditions are favorable. If planted in the open ground, the seeds should be placed in rows 3 or 4 feet apart, and 14 inches apart in the row, covering them with an inch or two of soil. It is well to cover the ground with a mulch of straw to prevent evaporation as much as possible.

446. Avocado.

The avocado is a rapid grower, and young plants require frequent repotting. It is also a gross feeder, so that a rich soil should be used. The plants may be budded either in pots or in the open ground; if in the former, they must be given very careful attention so as to keep them growing vigorously, and should be in 6- or 8-inch pots. They may be budded when ⅜ inch in diameter, or even slightly less.

For avocados, shield budding, essentially the same as practised with the citrus fruits, is most successful and advantageous. The amateur may have some trouble in performing the work successfully, but after a little experience, few difficulties will be encountered.

The season at which budding is most successful naturally depends somewhat upon the locality. In Florida, late autumn and winter budding is favored; in California, May and June seem to be the best, although good success is often obtained in the fall; in Hawaii winter and early spring are preferred. Probably the work can be done at any season when the bark will slip readily, but all seasons are not equally advantageous.

Selection of budwood is one of the most important matters, and one likely to give the novice most trouble. If the wood is too old or too far advanced, the buds are almost certain to drop, leaving a "blind" shield; this may happen even when good budwood is used, if the stock is not in vigorous condition. The ideal wood is of recent growth, but hardened up sufficiently so that it does not snap on bending, and having plump, well-developed buds.

It is essential that the buds be cut large,—not less than 1¼ inches in length, and thick enough so that a small quantity of wood will be taken. In budding large stocks, ¾ inch in diameter, 2 inches is not too long for the bud, provided the budstick is, as it always should be, not less than ⅜ inch in diameter. The budding-knife must be as keen as a razor, and kept in as nearly that condition as possible by frequent stropping or whetting the knife after cutting each thirty or forty buds. The incision in the stock may be made either in the form of a T or an inverted T, preferably the latter, which has the recommendation of the most successful avocado budders. In lifting the bark be careful not to injure the delicate tissues which lie under it, and push the bud in very gently. Tie it in firmly with waxed tape, leaving the eye exposed.

In three to five weeks the bud will have united with the stock, and the wrap should be loosened; it should not be entirely removed until the bud has made a growth of 3 or 4 inches. Force the bud into growth by partly girdling the stock 3 or 4 inches above it, or by cutting off the stock about a foot above it. Lopping is difficult, as the wood is brittle and will frequently break off rather than be lopped. The stock must be gone over every week and all adventitious buds rubbed off. When the bud is 8 or 10 inches high, the stock may be trimmed off close above it, and the stump covered with paint or grafting-wax.

Both inarching and grafting are practised to a limited extent, the latter usually under glass. Neither of these methods is so desirable as budding. Cuttings can be grown if bottom heat is available but trees produced in this way do not seem to have the vigor of budded trees.

Large, unproductive or undesirable seedlings should be worked over to a good variety. This is not difficult to do by budding; grafting is also possible. Cut the tree back severely in spring, leaving only the stumps of the largest branches, 3 or 4 inches in diameter, and painting the cut ends with white lead. Numerous sprouts will soon make their appearance; all but three or four of these on each branch must be rubbed off, and when these have attained a diameter of ¾ inch they can be budded in the same manner as seedlings. It is necessary to loosen the wraps oftener, however, as the sprouts naturally make a very rapid growth. Old trees worked over in this way will often produce fruit in two years.

F. W. Popenoe.

AZÀLEA (from Greek *azaleos*, dry: Linnæus believed them to grow in dry locations). *Ericàceæ*. See *Rhododendron*.

The genus Azalea seems botanically inseparable from Rhododendron; there are no characters by which the two genera can be clearly separated, though if one looks only at the American species and those generally in cultivation, the differences seem to be clear enough, but if one takes into consideration the whole genus, particularly as it is represented in Asia, where it reaches its greatest development, one finds many species that have the characters of these two groups combined in various ways and render a natural and clear separation impossible.

Most of the species retain the same specific or varietal name under Rhododendron, except the following:

A. álba, Sweet=Rhododendron rosmarinifolium.—*A. balsamineæflòra*, Carr.=R. indicum var. rosiflorum.—*A. californica*, Buckl.=R. occidentale.—*A. Danielsiàna* Paxt.=R. indicum var. macranthum.—*A. ledifòlia*, Hook.=R. rosmarinifolium.—*A. liliiflòra*, Poir.=R. rosmarinifolium.—*A. lùtea*, Linn.=R. calendulaceum.—*A. móllis*, Blume=R. sinense.—*A. móllis*, Miq.=R. japonicum.—*A. mucronàta*, Blume=R. rosmarinifolium.—*A. póntica*, Linn.=R. luteum.—*A. procúmbens*, Linn.=Loiseleuria procumbens.—*A. punícea*, Sweet=R. rosmarinifolium.—*A. reticulàta*, Koch=

R. rhombicum.—*A. Róllisonii*, Hort.=R. indicum var. rosiflorum. —*A. Siebòldii*, Miq.=R. indicum.—*A. speciòsa*; Willd.=R. calendulaceum.—*A. squamàta*, Lindl.=R. Farreræ.

ALFRED REHDER.

AZÀRA (I. N. Azara, a Spanish promoter of science, especially of botany). *Flacourtiàceæ*. Ornamental shrubs or small trees grown for their handsome evergreen foliage and also for their fragrant flowers.

Leaves evergreen, alternate, short-petioled, entire or serrate, with usually one of the stipules enlarged and lf.-like: fls. small, in axillary peduncled racemes or clusters, apetalous; sepals 4–5; with glands between the stamens and the sepals opposite the latter; stamens numerous, rarely 5; ovary superior, 1-celled, with numerous ovules; style simple, elongated: fr. a many-seeded berry.—About 20 species in S. Amer., especially in Chile.

They are handsome evergreen shrubs, with small or medium-sized foliage, inconspicuous but fragrant flowers, and therefore called "aromo" in Chile.

They can be grown only in warmer temperate regions; the hardiest species is *A. microphylla*. They are sometimes cultivated as greenhouse plants and potted in a sandy compost of loam and leaf soil. Propagation is by seeds or by cuttings of mature wood in autumn under glass with slight bottom heat.

microphýlla, Hook. f. From 3–12 ft.: lvs. obovate, serrate, or nearly entire, ½–¾in. long, shining, glabrous, the stipules similar, but half the size: fls. greenish in few-fld. clusters; stamens 5: berries orange. Feb., March. Chile. G.C. II. 1:81. Gn. 18, p. 403. Gt. 23, p. 340. F. 1874, p. 221.—Graceful evergreen shrub, regularly pinnately branched, excellent for covering walls; the hardiest of all the cult. species; hardy as far north as Washington, D. C.

Gílliesii, Hook. & Arn. Height 10–15 ft.: lvs. 2½–3 in. long, broad-ovate, with coarse, spiny teeth, glabrous; stipules orbicular, much smaller: fls. in dense, elliptic, nodding heads, yellow. Feb., March. Chile. B.M. 5178. F.S. 23:2445. G.C. II. 15:401.—The handsomest of all azaras.

A. crassifòlia, Hort.=A. Gilliesii.—*A. dentàta*, Ruiz. Height 12 ft.: lvs. obovate or elliptic, crenate-serrate: fls. yellow, in small corymbs. Chile. B.R. 1788.—*A. integrifòlia*, Ruiz. Height 10–20 ft.: lvs. entire: fls. yellow, in oblong heads. Chile. Has a variegated form.

ALFRED REHDER.

AZÓLLA (Greek, *to destroy by drying*). *Salviniàceæ*. A small genus of floating aquatics with small, pinnately branched sts. and minute fleshy 2-lobed lvs., producing 2 sorts of spores in globular sporocarps. The plants multiply rapidly by self-division, and will grow readily in water containing a little nutriment. The species are distinguishable only by microscopic examination. In natural conditions, the plants grow so closely together and multiply so rapidly as to cover very completely any quiet water surface. For this reason, they have been found useful in preventing the propagation of mosquitos in Germany and Panama.

caroliniàna, Willd. Plant ¾–1 in. long: anchor-like processes of spores with septa. N. Y. to the Gulf of Mex.

filiculoìdes, Lam. Plants 1–2 in. long: anchor-like processes without septa. Calif. to Chile.

L. M. UNDERWOOD.
R. C. BENEDICT.†

B

BABIÀNA (said to come from Dutch for *baboon*, because those animals eat the bulbs). *Iridàceæ*. About fifty cormous plants of South Africa (and one Socotran), sometimes grown for spring bloom under glass, or in the open in the South.

Usually less than 1 ft. tall: fls. showy, red or purplish, in a short spike-like cluster or raceme, tubular at the base, the segms. with claws or narrow bases, and the limb erect-spreading, in marked colors and shades, often fragrant; ovary 3-loculed: lvs. narrow, hairy, plaited, standing edgewise to the st.

Low plants, of easy culture if treated like freesias or hyacinths. Three or four corms placed in a 4-inch pot, in autumn, give attractive bloom in March or later. Grown only indoors or under frames in the North. Outdoors in mild climates they may remain continuously in the ground, although it is better to take up and replant every year or two. Propagation is by cormels and seeds. They are showy and useful plants. Monograph by Baker in Handbook of the Irideæ, 1892.

447. Babiana stricta. (×¼)

A. *Perianth-limb regular or nearly so, and wide-spreading.*

stricta, Ker (*B. villòsa* and *B. purpùrea*, Ker). Fig. 447. Plant 1 ft. or less high: lvs. broad, oblong-lanceolate or sword-shaped, barely reaching the spikes: fls. scattered, showy, usually red or purple, with a prominent tube, the segms. oblong-lanceolate. B. M. 583, 621.—Babianas are not sold under species-names in this country, but as mixed varieties. These varieties are chiefly, if not wholly, of this species. There are many forms and colors. Var. **angustifòlia**, Sweet. Lvs. linear: fls. blue, pinkish inside. B.M. 637. Var. **rùbrocyànea**, Ker. Limb lilac, throat red. B.M. 410 (as Ixia). Var. **sulphùrea**, Ker. Yellow or whitish. B.M. 1053. Two other long-cult. types are described below.

AA. *Perianth-limb distinctly ringent or gaping.*

plicàta, Ker. Low: lvs. lanceolate, hairy, usually overtopping the spikes: fls. lilac or red, long-tubed, the segms. oblong and unequal; odor pink-like. B.M. 576.

dísticha, Ker. Differs from the last in having the perianth-tube distinctly exserted from the spathe; odor hyacinth-like. B.M. 626.

B. flabellifòlia, Harv. Fls. 2–5, in erect spike, long-tubed, lower lobes blotched: lvs. ¾in. broad, toothed at apex.—*B. ringens*, Ker. 6–10 in.: fls. gaping and ringent, scarlet: lvs. narrow and pointed.—*B. sambùcina*, Ker. 6–10 in.: fls. purplish, with spreading divisions, elder-scented. B.M. 1019.—*B. socotràna*, Hook. f. 3–4 in.: fl. single, the tube very slender, pale blue, 2-lipped: lvs. narrow-lanceolate. Isl. of Socotra. B.M. 6585.

L. H. B.

BABY'S BREATH: *Gypsophila;* also *Galium* and *Androstephium.*

BACCAÙREA (Greek, *bacca*, berry, and *aureus*, golden, from the yellow fruit). *Euphorbiàceæ*. Trees, rarely cult., some with edible fr.: lvs. large, alternate, simple: infl. racemose; calyx imbricate; petals absent; 2 ovules in each of the 2–5 cells.—About 50 species in the Old World tropics: related to Antidesma. **B. bracteàta**, Muell. Arg. (*Pieràrdia dúlcis*, Wall.), is mentioned as once intro. to England. Malaya. Seed of **B. Motleyàna**, Muell. Arg., of Malaya where the fr. is used, has been intro. by the U. S. Dept. Agric.

J. B. S. Norton.

BÁCCHARIS (*bakkharis*, an ancient Greek name for different shrubs). *Compósitæ*. Groundsel Tree. Ornamental plants, chiefly grown for the showy white pappus of the fruit; some species also for their evergreen foliage.

Shrubby or suffruticose: lvs. alternate, usually serrate, glabrous, deciduous or evergreen: heads of fls. small, white or yellowish, dicœcious, in panicles or corymbs; involucre with many imbricate scales; receptacle flat, naked; pistillate fls. with filiform corolla: achenes compressed, ribbed, with pappus.—More than 250 species in Amer., chiefly in S. Amer.

Baccharis halimifolia and *B. salicina* are hardy North, while the evergreen species are more tender. They grow in almost any well-drained soil in a sunny position, and are well adapted for dry and rocky slopes, and valuable for seashore planting. Propagation is by seeds, or by cuttings under glass.

halimifòlia, Linn. Shrub, 3–12 ft.: branches angular: lvs. cuneate, oblong or obovate, coarsely toothed, the uppermost entire, glabrous, 1–2 in. long: fls. in large panicles: pappus white, about ½in. long. Sept. Seacoast, from New England southward. Gng. 7:113.—The hardiest species; in fr. resembling a shrub with abundant snow-white fls.

B. glomeruliflòra, Pers. Allied to B. halimifolia: heads axillary, solitary or clustered, sessile or nearly so: pappus somewhat shorter. N. C. to Fla.—*B. patagònica*, Hook. & Arn. Low evergreen shrub: lvs. ⅛–½in. long: heads mostly axillary. Patagonia.—*B. pilulàris*, DC. Height 6 ft.; evergreen: lvs. 1 in. long: heads in racemose panicles. Pacific coast.—*B. salicina*, Torr. & Gray (B. salicifolia, Nutt.). Allied to B. halimifolia. Lvs. narrow-oblong, or linear-lanceolate. Colo. to W. Texas.

Alfred Rehder.

BACHELOR'S BUTTONS: *Centaurea Cyanus, Gomphrena globosa, Ranunculus acris* and *Ageratum conyzoides.*

BACKHOÙSIA (James Backhouse, botanical traveler). *Myrtàceæ*. Evergreen greenhouse plants, blooming in spring.

Shrubs or trees, with opposite lvs. and blossoms in cymes or umbels: calyx-tube turbinate, or broadly campanulate, adhering to base of ovary, with 4 persistent segms.; petals 4, short; stamens many; ovary 2-celled, bearing a filiform style: fr. a caps., more or less inclosed in calyx, indehiscent or separating into 2 parts.—Five species in Austral. Requires the general treatment of myrtaceous coolhouse plants. Prop. by hardening cuttings under glass.

myrtifòlia, Hook. & Harv. Large slender-branched shrub, or small tree: lvs. ovate-acuminate, stiff, pellucid-punctate: fls. white, in pedunculate corymbs, the younger ones partly concealed by the petaloid bracts; petals small, round-ovate, concave, acute; calyx hairy. Queensland and New S. Wales. B.M. 4133.

L. H. B.

BÁCTRIS (Greek, *baktron*, cane; the young stems used for walking-sticks). *Palmàceæ*, tribe *Bactrideæ*. Usually low palms, very rarely entirely spineless.

Stems solitary or fasciculate, ringed, spiny or smooth, sprouting from the roots: lvs. terminal or scattering,

equally or unequally pinnatisect, glabrous or pubescent; segms. sparse or aggregated, or more or less imperfectly connate, forming a bifid blade, acute or rarely obtuse at the apex, the ciliate margins recurved at the base; petiole short or long; sheath long, spiny: spadices sessile or pedunculate, perforating the lf.-sheaths; spathes 2, the lower short, open at the apex, the upper coriaceous or woody, exceeding the spadix, or fusiform, ventrally dehiscent, smooth, bristly or spiny; bracts persistent: fls. small or medium, pale yellow or greenish: fr. small, green, ovoid or globose.—Species 90. Trop. Amer. G.C. II. 22:595.

These are ornamental palms, but little grown on account of the spines. The fruits of *B. major* are used extensively in South America for food.

The cultivation of bactris is easy if it is grown in a warmhouse, with a range of temperature from 60° to 80°, and given plenty of water. Frequent syringing is advisable. It thrives best in a mixture of loam, two parts; leaf-mold, one part; well-rotted cow-manure, one part. The young plants are very decorative, but in age most of the species become spindly.

Propagation is by suckers which grow freely; rarely by seeds, which are hard to get.

A. *Spines yellow, tipped black.*

pallidispìna, Mart. (*B. flavispìna*, Hort.). St. 10–18 ft. high, 1–2 in. diam., the internodes spiny: lvs. showy, 5–9 ft. long, equally interruptedly pinnatisect; petiole 4–6 ft., brown-scaly, thickly covered with very long (¾–2¼ in.), black-tipped yellow spines, either solitary or in groups of 2–4; segms. linear-lanceolate, caudate-acuminate, prickly on the margins, the basal ones 2–8 in. long, 1½ in. wide, the upper, 12 x 1¼ in.: fr. 3–4 times exceeding the persistent calyx, about 1½ in. long. Brazil.

AA. *Spines black.*

B. *Lf.-segms. acute at both ends.*

màjor, Jacq. Beach Palm. St. 9–15 ft. high, 1–1½ in. diam., armed with rows of black spines 2 in. long: petiole armed with very long black, terete spines; lvs. 4–6 ft. long, equally pinnatisect nearly to the rachis; sheath and rachis spiny and white or brown tomentose; segms. linear, acute at both ends, 25–35 on each side, 1-nerved, 8–12 in. long, ½–½in. wide, glabrous on both sides, densely setose, with black hairs along the margin.: frs. about the size of an apricot, edible. Brazil.

mìnor, Jacq. Fig. 448. A tall, slender-stemmed palm, often 40 ft. in height, armed with many dark-colored spines: lvs. roundish in outline, about 3 ft. long and composed of numerous narrow, sharp-pointed lfts. that are spiny on the veins beneath: spathe axillary, solitary, spreading, very spiny; corolla in both sexes gamopetalous: fr. rotund, purplish black.—A rare but showy palm grown sometimes in tropics.

BB. *Lf.-segms. acute at tip.*

Gasipàës, HBK. (*Guiliélma speciòsa*, Mart.). St. about 60 ft. high, single or cespitose, with rings of subulate-compressed black spines, 1 in. long, the rings about as far apart as the diam. of the st.: lvs. 6 ft. long, curving; segms. dark green above, pale green below, very numerous, approximate, 1½ ft. long, 1¼ in. wide, linear-lanceolate, long-acuminate, bristly or minutely prickly along the margins: fr. orange or reddish, nearly 2 in. long, ovoid. Lower Amazon.

hórrida, Oerst. Cespitose sts. 6–8 ft. high, 8–9 in. diam., very spiny, sheathed for most of its length with bases of dead lvs.; spines 3–4 in. long, 4-sided, whitish tomentose, at length glabrous: lvs. 2⅓–3 ft. long; sheath 8 in., brown-tomentose; petiole 1½ ft., densely spiny, subtetragonal, densely brown-tomentose beneath; segms. 7 in. long, ½in. wide, lanceolate, rigid, glaucous. Unlike all the above in having a hairy but not spiny spathe. Nicaragua.

B. aurantìaca, Hort., is a "pinnate palm from Mex., dwarf and spiny but beautiful." The name is unknown in botanical literature. —*B. caryotæfòlia*, Mart., from Brazil, with wedge-shaped 3-lobed pinnæ, has been catalogued; also *B. útilis*, Benth. & Hook. (Guilielma utilis, Œrst.), from Costa Rica, with spiny petioles and young lvs.

N. Taylor.†

BACULÀRIA (Latin, *baculum*, a small walking-stick). *Palmàceæ*, tribe *Arèceæ*. Two or three small palms, completely spineless. By some, included in *Linospadix*.

Stems very thin, either solitary or in bunches, which are prominently ringed: lvs. usually numerous, terminal, unequally pinnate, and with relatively short petioles; lfts. coriaceous, usually alternate, from 4–6 pairs, strap-shaped, and with incised or much-laciniated apices, attached by a broad, almost decurrent base; nerves prominent, numerous on older lfts., on small ones solitary: spathes in pairs; spadix consisting of a long spike-like cluster, as long as or longer than the lvs.; fls. in 3's, a female with 2 males in each cluster on the green spadix: fr. small, obovate or ovoid, green, from ¼–¾ in. long. The genus is confined to temperate and tropical Austral. G.C. II. 22:595.

448. Bactris minor.

For general culture, see *Areca*, to which they are allied. The only species known in cultivation seem to do better in a temperate rather than a tropical house, but shifting will probably be found advantageous. One of the smallest palms in cultivation, *B. monostachya* is very popular, particularly in England.

monostàchya, F. Muell. (*Arèca monostàchya*, Mart. *Kéntia monostàchya*, F. Muell.). Walking-stick Palm. Trunk 6–12 ft. high, scarcely 1 in. thick: lvs. 1½–4 ft. long; the sheath broad, coriaceous, about 6 in. long, produced into 2 stipular lobes; segms. very irregular, acuminate, very variable in breadth and distance, adnate to the rachis, or tapering at the base, the longest about 1 ft. long: infl. very long, often exceeding the lvs.; stamens usually 10: fr. ovoid, about ½in. thick. Queensland, New S. Wales. B.M. 6644.

mìnor, F. Muell. Sts. several from the same rhizome, 2–5 ft. high, about ½in. thick: lvs. about 3½ ft. long, with from 12–14 lfts.: spadix about as long as the lvs. or a little shorter, scarcely ½in. thick; stamens 12; seed about ½in. diam. Queensland.—A delicate palm, not so well known as the preceding, but attractive.

N. Taylor.†

BAÈRIA (after the Russian zoölogist, Karl Ernst von Baer). *Compósitæ*. Small plants, one of which is sometimes grown as a garden annual.

Heads usually many-fld., radiate, the rays 5–15; bracts of the involucre as many as rays; pappus often wanting.—Twenty species of Californian annuals (or one or two perennial species), with numerous showy, inch-wide yellow fls. in early summer.

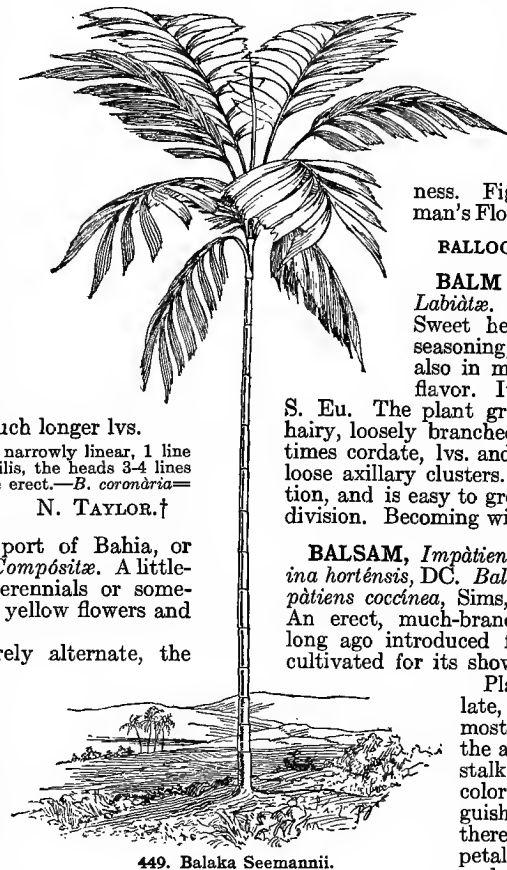
grâcilis, Gray (*Burrièlia grácilis*, DC.). Easily distinguished from *Actinolepsis coronaria* by its hairy sts. and foliage and undivided lvs.: plant much branched: height 4–12 in.: lvs. opposite, connate, linear-lanceolate: fls. solitary, on slender terminal peduncles; involucre leafier than in *Actinolepsis coronaria*, the scales longer, downy, in 2 series; rays 8–12. B.M. 3758.—This is likely to be cult. as *Lasthenia californica*, which, however, is not hairy and has much longer lvs.

B. chrysóstoma, Fisch. & Mey. Lvs. narrowly linear, 1 line or less wide: fls. larger than in B. gracilis, the heads 3-4 lines high; ligules 3-4 lines long: habit more erect.—*B. coronària*= Actinolepsis coronaria.

N. TAYLOR.†

BAHÌA (probably from the port of Bahia, or San Salvador, South America). *Compósitæ*. A little-known group of herbaceous perennials or sometimes subshrubs grown for their yellow flowers and canescent leaves.

Leaves mostly opposite, rarely alternate, the rather small pedunculate heads terminating the branches; involucre hemispheric or obovate; receptacle mostly flat: achenes narrow, 4-sided; pappus of several scarious scales.—There are 12 species, all American. They thrive on borders of light and well-drained soil, and may be increased by seeds or by division in spring.



449. Balaka Seemannii.

lanàta, DC. One to 2 ft. high, slender: lvs. pinnately cleft or divided into 3–7 linear or linear-lanceolate lobes: rays mostly 8–9, oblong, showy: achenes glabrous or minutely hairy. Calif. B.R. 1167 (as *Eriophyllum*).—Perhaps not hardy in the N. E. Summer. N. TAYLOR.

BAIKIÆA (Wm. B. Baikie, African traveler). *Leguminòsæ*. Great-flowered Trop. African trees of 2 species, one of which has been cult. in Eu. Trees unarmed: lvs. abruptly pinnate, coriaceous: fls. few in each raceme, not papilionaceous; petals 5, much exceeding the turbinate calyx, broadly oblanceolate or obovate, long-clawed; stamens 10. *B. insígnis*, Benth., is an erect evergreen, to 40 ft., with short-lined fls. 10 in. across, snow-white with lower petal or lip lemon-yellow. Upper Guinea.—Said to be the largest flower in the Leguminosæ.

450. Pod of garden balsam.

BALÀKA (the Fijian vernacular name). *Palmàceæ*, tribe *Arèceæ*. Palms, differing, if at all, from Ptychosperma, to which they are with equal propriety referred, in having the seed not sulcate, and in the half-rhomboid segms. of the lvs.; and from Drymophlœus in the form of the lf. and the caducous spathes. —Species 2. Fiji Isls.

Seèmannii, Becc. (*Ptychospérma Seèmannii*, H. Wendl.). BALAKA. Fig. 449. Caudex slender, 8–12 ft. high, straight, ringed, about 1 in. diam.: lvs. pinnatisect, 4 ft. long; segms. erose-dentate at the apex, alternate, 9 on each side, semi-rhomboid, obliquely truncate, the upper margin longer, cuspidate at the apex, the terminal one deeply bifid. Growing as underwood in dense forests. Fiji.—Sts. used for spears by natives, because of their strength and straightness. Fig. 449 is adapted from Seeman's Flora Vitiensis. N. TAYLOR.†

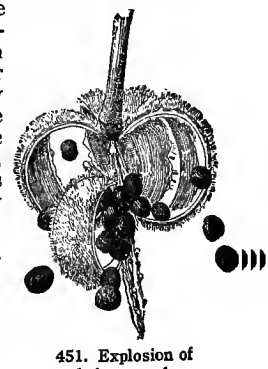
BALLOON VINE: *Cardiospermum*.

BALM (*Melissa officinàlis*, Linn.). *Labiàtæ*. LEMON BALM and BEE BALM. Sweet herb, the lvs. being used for seasoning, particularly in liquors, and also in medicine. It has a lemon-like flavor. It is a hardy perennial from S. Eu. The plant grows 1–2 ft. high, somewhat hairy, loosely branched, with ovate-petioled, sometimes cordate, lvs. and yellowish or whitish fls. in loose axillary clusters. Thrives in any warm position, and is easy to grow. Prop. by seeds; also by division. Becoming wild in E. U. S.

BALSAM, *Impàtiens Balsámina*, Linn. (*Balsámina hortènsis*, DC. *Balsámina Impàtiens*, Hort. *Impàtiens coccínea*, Sims, B.M. 1256). *Balsaminàceæ*. An erect, much-branched, half-succulent annual, long ago introduced from India, and now widely cultivated for its showy flowers.

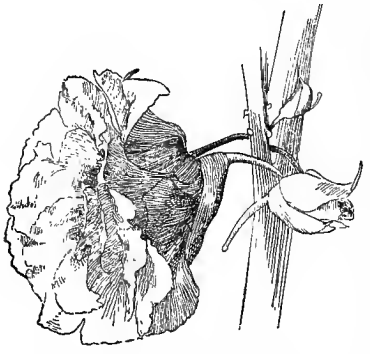
Plant 1½–2½ ft.: lvs. lanceolate, toothed, the lower ones being mostly in pairs: fls. clustered in the axils of the lvs., on very short stalks; sepals and petals similarly colored and not easily distinguished, one of the sepals (of which there seem to be 3) long-spurred; petals apparently 3, but 2 of them probably represent 2 united petals, thus making 5; stamens 5. The pod, shown in Figs. 450 and 451, is explosive. It has 5 carpels and very thin partitions, and seeds borne on axile placentæ. When the caps. are ripe, a pinch or concussion will cause the valves to separate and contract, the seeds being thrown with considerable force. The balsam has varied immensely in the doubling, size and color of its fls. and in the stature of the plant. It was known to Gerarde in 1596. The balsam is sometimes called "lady slipper," although this name is properly confined to Cypripedium, and used for Calceolaria.

Practically all the garden balsams are now double or semi-double. The full-double forms are known as the camellia-flowered varieties. Fig. 452. In well-selected stock, the greater part of the flowers from any batch of seedlings should come very double. The colors range from white to dark blood-red, yellowish and spotted. Balsams are of very easy culture. They are tender, and should be started in thumb-pots or boxes indoors, or in the open when danger of frost is past. The seeds are large, and germinate quickly. The plants prefer a rich, sandy loam, and must not suffer for moisture Transplanting, and



451. Explosion of balsam pod.

pinching-in the strong shoots, tend to make the plants dwarf and compact; two or three transplantings are often made. It is well to remove the first flower-buds, especially if the plants are not thoroughly established. Better results are secured when only a few main branches are allowed to grow, all the secondary and weak ones being pinched out. Sometimes they are pruned to a single stem, and if much room is given very large blooms are secured. The lower leaves may be removed if they obscure the flowers. Well-grown bushy plants should stand 2 feet apart each way, and the tall kinds will reach a height of 2 to 2½ feet. Good bloom is impossible if plants are crowded. For this reason, balsams do well in rows on the border of a garden where they may have room. Seed of the finest double strains is expensive, but inferior or common seed gives little satisfaction. Plants started early in May should give flowers in July, and should bloom until frost. A full-grown plant is shown in Fig. 453. At present, balsams are grown chiefly as flower-garden plants; but some years ago the flowers were largely used as "groundwork" in florists' designs, particularly the double white varieties. The flowers were wired to toothpicks, and were then thrust into the moss that formed the body of the design. L. H. B.



452. Camellia-flowered balsam. (×1)

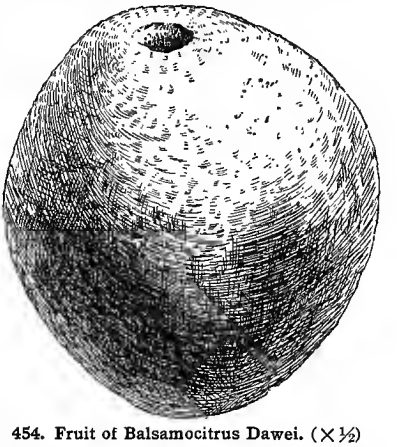
BALSAMOCÍTRUS (Latin, *balsamum*, balsam, and *citrus*). *Rutàceæ*, tribe *Cítreæ*. Trees; usually spiny, suggested as stocks for citrous fruits; as yet scarcely known in this country.

Fruits hard-shelled and persistent: lvs. trifoliolate, or rarely simple: fls. 4–5-parted; stamens 10–20; ovary 8–9-celled; ovules numerous in each cell; seeds large, smooth; hypocotyl very short, the cotyledons remaining near or just above the surface of the ground. The first foliage lvs. are opposite, lanceolate or ovate.—Three species are known, all occurring in Trop. Afr. *B. Dawei* is the type species.

453. The garden balsam.

The subgenus Afrægle (Latin, *Africa* and *Ægle*) differs from Balsamocitrus proper in having more than twice as many (usually 4 times as many) stamens as petals and in having a larger, more deeply lobed disk. *B. paniculata* is the type of this subgenus.

Dáwei, Stapf. Fig. 454. A large tree, 50–60 ft. or more in height: first few foliage lvs. on young plants simple but next succeeding ones 3-foliolate; lateral lfts. three-fifths to three-fourths as long as the terminal lft., having a cylindrical petiolule ⅜–½in. long; terminal lft. with a much shorter petiolule, ⅛–¼in. long, but usually borne on a section of the rachis ½–1½ in. long, jointed both at the insertion of the lateral lfts. and also where the petiolule of the terminal lft. is inserted (such imperfectly pinnate lvs. are not uncommon in some pinnate-lvd. plants but are rare in trifoliolate species): fls. 5-merous with 10 free stamens (twice as many as the petals): frs. globose or oval, 4–6 in. diam., with a very thick, hard woody rind and 8 oval cells surrounded by the more or less fibrous mesocarp tissue; cells contain numerous seeds imbedded in amber-colored, fragrant gum. The ripe frs. drop off the pedicel, leaving a hole through the shell where they were attached. The seeds are large, ½–¾ x $\frac{3}{16}$–⅜in., smooth, and germinate with a very short hypocotyl, often bringing the cotyledons to the surface of the ground or just above it. Occurring in the Budongo forest east of Lake Albert Nyanza in Uganda, E. Cent. Afr., at an altitude of 2,000–3,000 ft. —The seedlings grow very rapidly. Experiments indicate that this is a very promising stock on which to graft the bael fruit (*Ægle Marmelos*), which it is difficult to grow on its own roots. Ill. Journ. Linn. Soc. Bot. 37, pl. 22.



454. Fruit of Balsamocitrus Dawei. (×½)

paniculàta, Swingle (*Citrus paniculàta*, Schum. *Ægle Bárteri*, Hook. f. *Limònia Warnéckii*, Engler). Fig. 455. A handsome tree, 20–45 ft. high and much branched: lvs. on old trees trifoliolate, the lateral lfts. about two-thirds as long as the terminal one and narrowed into a slender petiolule ⅛–$\frac{3}{16}$in. long; terminal lft. has a long slender petiolule ½–¾in. long but there seems to be no articulation where it joins the lamina as in case of *B. Dawei;* spines are said to be solitary, from 1–4 in. long but are wanting on fruiting branches: fls. usually 4-merous, sometimes 5-merous; stamens 13–20, normally 4 times as many as the petals; ovary 8- or 9-celled; disk large, lobed: frs. spherical or obovoid, 3–5 in. diam., with a thick woody rind, green until maturity, then taking on a gray color; cells of fr. contain numerous smooth seeds; germination unknown.—Commonly planted in the villages of Nigeria and the Gold Coast in Trop. W. Afr. This species has not yet been intro. into cult., but it is to be hoped that seeds will be secured from Afr. to permit its being tested as a stock for citrous frs. Ill. Hooker, Ic. 37, pl. 2285. Bull. Soc. Bot. Fr. v. 58, Mem. 8d., pl. 1–2.

gabonénsis, Swingle. A little-known tree or shrub: lvs. narrowly lanceolate, simple, with short petioles: vigorous young trees, when they have reached a height of 8 or 10 ft., begin to show trifoliolate lvs. with relatively small lateral lfts. from one-third to one-half as long as the terminal lft. and like it acute at both ends; terminal lft. sessile: fls. unknown: fr. nearly globular, slightly pear-shaped, with a thick woody rind.—The natives remove the contents through an opening at the stem end and use

the empty fr. as a powder-flask. Native to the M'fan or Pahouin country in N. French Congo and S. Kamerun where the fr. is known to the French residents as "poire à poudre" (powder-flask). This species grows very rapidly under greenhouse conditions. It has been grafted successfully on the tabog (*Chætospermum glutinosa*), a related tree native to the Philippines, and may prove of value as a stock for citrous fruits on account of its vigor and healthiness. Ill. Bull. Soc. Bot. Fr. v. 58, Mém. 8d, pl. 3, and Fig. B., p. 235.

WALTER T. SWINGLE.

BALSAMORRHÌZA (Greek, *balsam root*). *Compósitæ.* Low perennials with thick, deep, resinous, frequently tuberous roots, tufts of radical lvs., and large yellow fls.: lvs. usually long-petiolate, when cauline usually opposite, mostly radical: scapes few-lvd. or naked; fls. usually solitary. The root was an aboriginal food, when the rind was peeled.—About 10 species, mostly from Cent. and W. N. Amer.

Hoòkeri, Nutt. Canescent: height 4–12 in.: lvs. lanceolate, 1–2-pinnately parted: fls. solitary, on naked scapes.—Intro. 1881 by E. Gillett, but scarcely known to horticulturists. Useful in dry situations.

N. TAYLOR.

455. Balsamocitrus paniculata. (×⅝)

BAMBOO. Various perennial ornamental grasses embracing the genera and species of the tribe *Bambùseæ*, order *Gramíneæ*, cultivated for the surpassing beauty of their foliage and habit; some of them are hardy even in parts of the northern states, but they are warm-country plants.

Usually large, sometimes tree-like, woody, rarely herbaceous or climbing plants, of wide geographical range. The species are irregularly distributed throughout the tropical zone, a few occurring in subtropical and temperate zones, attaining their maximum development in the monsoon regions of Asia.—About twenty-three genera, only two being common to both hemispheres. Something more than 200 species are recognized, of which upwards of 160 occur in Asia, about seventy in America, and five in Africa. They extend from sea-level to altitudes of more than 10,000 feet in the Himalayas and 15,000 feet in the Andes, and under the most favorable conditions some species may attain a height of 100 to 120 feet, with a diameter of culm of 8 to 12 inches.

An attempt to enumerate the numerous and varied economic uses of the giant-grasses would greatly overreach the field of this article; but as objects of grace and beauty in the garden, conservatory, and under special conditions of landscape, bamboos are matchless. Not only are they adapted to sections favored with a gentle climate, but it is possible to grow certain species where the cold of winter may reach zero Fahrenheit, or even occasional depressions of greater severity.

Bamboos delight in a deep, rich loam, and generously respond to good treatment. A warm, slightly shady nook, protected from the prevailing cold winds of winter, and in which moist but well-drained soil is plentiful, is an ideal location. A top-dressing of manure and leaves is not only beneficial in winter, by preventing the frost from penetrating the ground too deeply, but it also preserves the moisture that is so essential to the welfare of the plants during the growing season. Some species produce rampant subterranean stems, and spread rapidly when once established. These should not be planted for ornamental purposes, but only those forming tufts or clumps. It is best to plant each group of but a single species, and to restrict the wide-spreading sorts to isolated positions. The most effective results to be obtained by planting bamboos are secured on gentle banks above clear water, and against a background of the deepest green. In such situations the graceful stems and dainty branches, bending with their wealth of soft green leaves, and the careless lines of symmetry of each individual, lend a bold contrast of the richest beauty. Ordinarily it will require two or three years thoroughly to establish a clump of bamboos in the open air, and, until this is accomplished, the vigor, hardiness and beauty that characterize some noble kinds will be lacking. During the first few years, a new plantation should receive generous protection in localities in which the winters are trying, and even with this precaution it is likely the plants will suffer to some extent in cold weather. Planted out in conservatories or confined in tubs or large pots, the bamboos present many admirable qualities, and, as decorative plants, several species offer many inducements to their cultivation, especially as they may be grown and used out-of-doors in the summer and cheaply wintered in a coolhouse.

Propagation is best effected by careful division of the clumps before the annual growth has started. The difficulty of procuring seeds in some instances is very great; indeed, the fruiting of a number of species has never been observed. Some species flower annually, but the majority reach this stage only at intervals of indefinite and frequently widely separated periods. In some species the flowers appear on leafy branches; in others the leaves fall from the culms before the flowers appear, or the inflorescence is produced on leafless, radical stems. Fructification does not exhaust the vitality of some species; but others, on the other hand, perish even to the portions underground, leaving their places to be filled by their seedling offspring. Owing largely to the difficulty in obtaining flowering specimens, the systematic arrangement or nomenclature of the bamboos is in a sad plight. As it is sometimes even impossible to determine accurately the genus without flowers, the correct positions of some forms are not known.

Four sub-tribes of Bambuseæ are accepted by Hackel, namely: *Arundinarieæ.*—Stamens 3: palea 2-keeled: fr. with the seed grown fast to the seed-wall. To this belong Arundinaria and Phyllostachys. *Eubambuseæ.*—Stamens 6: fr. with the seed fused to a delicate seed-wall. Bambusa is the only garden genus. *Dendrocalameæ.*—Stamens 6 (rarely more): palea 2-keeled: fr. a nut or berry. Here belongs Dendrocalamus. *Melocanneæ.*—Characters of the last, but palea not keeled. Melocanna is an example, an extra-tropical genus, probably not in cult. in the U. S.

The genera Arundinaria, Phyllostachys, Bambusa and Dendrocalamus contain the most important species in cultivation. Roughly, the species of Arundinaria may be separated from Phyllostachys by the persistent sheaths and cylindrical stems. In Phyllostachys the sheaths are early deciduous, and the internodes, at

least those above the base, are flattened on one side. Generally, Arundinaria and Bambusa cannot be separated by horticultural characters, and Dendrocalamus is hardly separable except by its great size. It is probable that many of the forms now classed as species of Bambusa will eventually be found to belong to other genera, especially to Arundinaria. Extended information regarding the Bambuseæ may be found in the following publications: Munro's Monograph, in Transactions of the Linnæan Society, Vol. XXVI (1868); Hackel, in Die Naturlichen Pflanzenfamilien, Vol. II, part 2, p. 89 (1887), English Translation by Lamson-Scribner & Southworth, as The True Grasses, New York, 1890; papers by Bean in Gardeners' Chronicle III, 15:167, et seq. (1894); Freeman-Mitford, The Bamboo Garden, 1896, New York, The Macmillan Company, pp. 224; A. & C. Rivière, Les Bambous, Paris, 1879; Gamble, The Bambuseæ of British India, Calcutta and London, 1896; Houzeau, Le Bambou, Mons., 1906; Fairchild, Japanese Bamboos, 1903; Franceschi, Bamboos in California, Santa Barbara, 1908. Among the hardiest of the bamboos are the following: *Phyllostachys Henonis, P. nigra, P. viridi-glaucescens; Arundinaria macrosperma, A. japonica, A. nitida; Bambusa palmata, B. tessellata* and *B. pygmæa.*

The list of descriptions contains the important kinds of bamboos in cultivation in America, and following the classified descriptions will be found a list of species, showing those that are more or less rare in gardens, but procurable from time to time through horticultural catalogues or prominent growers. An attempt has been made to separate the hardier forms of bamboos from the tenderer kinds by the character of the venation of the leaves, a distinction that has been enthusiastically entertained by Freeman-Mitford in his most estimable work, a book that has done much to create a popular appreciation of bamboos, and also to clear up the complete confusion into which the trade names have fallen.

Bamboos have slowly but persistently increased in popular esteem, especially in the southern and Pacific states, where they have proved their great beauty and usefulness as garden ornamentals. A new impetus has been given the cultivation of these plants by the dissemination of suitable species and varieties, and by the introduction of new and desirable kinds by commercial horticulturists and the U. S. Department of Agriculture.

In the following taxonomy, A.=Arundinaria; B.=Bambusa; D.=Dendrocalamus; P.=Phyllostachys; T.=Thamnocalamus, which is here considered a subgenus of Arundinaria. No Japanese native names are indicated, although bamboos are sometimes offered under such names. The prevailing tendency is to discard vernacular names, when unassociated with the Latin binomials, as they breed hopeless confusion.

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A. chrysantha, 20.
B. chrysantha, 20.
A. debilis, 32.
A. decidua, 11.
B. disticha, 4.
B. erecta, 14.
A. falcata, 34.
B. falcata, 34.
A. Falconeri, 33.
T. Falconeri, 33.
B. fastuosa, 9.
A. Fortunei, 7, 17, 18.
B. Fortunei, 17, 18.
B. gracilis, 33.
D. Hamiltonii, 37.
B. Henonis, 27.
P. Henonis, 27.
A. Hindsii, 14.
A. Hookeriana, 35.
A. humilis, 7.
A. japonica, 12.
P. Kumasaca, 30.
D. latiflorus, 38.
A. macrosperma, 10, 11.
A. marmorea, 16.
B. marmorea, 16.
B. Maximowiczii, 13.
B. Mazelii, 26.
D. membranaceus, 39.
B. Metake, 12.
B. mitis, 25.
P. mitis, 25.
B. nana, 4.
A. Narihira, 13.
B. Narihira, 13.
B. nigra, 21.
P. nigra, 21.
A. nitida, 8.
A. nobilis, 31.
B. palmata, 2.
B. plicata, 13.
A. pumila, 6.
B. pumila, 6.
P. punctata, 21.
B. pygmæa, 5.
B. quadrangularis, 15.
B. Quilioi, 26.
P. Quilioi, 26.
B. Ragamowskii, 3.
B. ruscifolia, 30.
P. ruscifolia, 30.
A. Simonii, 13.
B. Simonii, 13.
D. strictus, 41.
A. tecta, 11.
B. tessellata, 3.
A. Veitchii, 1
B. Veitchii, 1.
B. Vilmorinii, 19.
B. viminalis, 30.
B. violescens, 22.
P. violescens, 22.
B. viridi-glaucescens, 28.
P. viridi-glaucescens, 28.
B. viridi-striata, 13.
A. viridis, 17.
B. vulgaris, 36.

SECTION I.—*Venation conspicuously tessellate, i.e., the veins crossing one another like the meshes of a net, visible to the naked eye by holding a lf. up to the light, or more clearly seen by the use of a lens. (Embraces the hardier types of bamboos, 1–30.)*

A. *Internodes not flattened: sheaths persistent.*

B. *Lvs. relatively very broad, usually 2 in. wide, or more.*

1. **A. Veîtchii**, N. E. Br. (*Bambùsa Veîtchii*, Carr.). Fig. 487. Height usually 3 ft. or less: sts. purple, white-waxy below the nodes: lvs. 5–8 in. long, about 2 in. wide, bright green above, below pale and minutely pubescent, serrate. Japan. M. 77, but not G.C. III. 15:169, or R.B. 23, p. 270, which are pictures of *B. palmata*, as explained in G.C. III. 15:209.—This is also liable to confusion with *B. tessellata*, but may be separated by lf. characters. Quite hardy, but the edges of the lvs. wither in late autumn, giving a variegated but injured appearance.

2. **B. palmàta**, Burbidge. Fig. 488. Height 2–5 ft.: lvs. 10–15 in. long, 2–3½ in. wide, bright green, serrate, smooth and shining above, below pale and minutely pubescent; longitudinal veins very prominent. Japan. M. 79. Gn. 49, p. 59, shows a clump 36 ft. in circum.—A beautiful, broad-lvd. ornamental.

456. Bambusa tessellata. (×$\frac{1}{10}$)

3. **B. tessellàta**, Munro (*B. Ragamówskii*, Hort.). Fig. 456. Height 3–4 ft.: lvs. 12–18 in. long, 2–4 in. wide, smooth and shining above, whitened beneath, sharply serrate; midrib prominent and bearing a tomentose line on one side. China and Japan. G.C. III. 15:167; 18:189. R.B. 23, p. 269.—Produces the largest lvs. of any of the hardy bamboos in cult., which is especially remarkable on account of its dwarf habit. Much confused in gardens, but unnecessarily, with *A. Veitchii*, as the tomentose line on one side of the midrib is unique in *B. tessellata*. The lvs. are used by the Chinese for wrapping tea.

BB. *Lvs. distinctly narrower.*

C. *Foliage green.*

D. *Plants low, usually 1–3 ft. in height.*

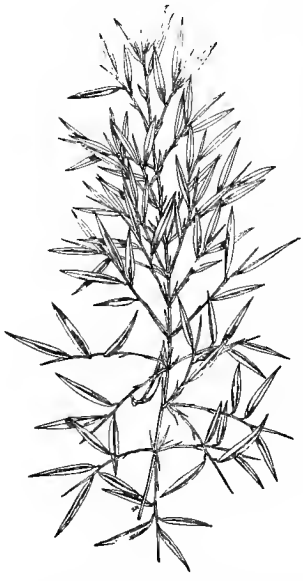
E. *Arrangement of lvs. distichous.*

4. **B. dísticha**, Mitford (*B. nàna*, Hort., not Roxbg.). Height 2–3 ft.: sts. zigzag, slender, green or tinged with purple: branches borne singly: lvs. 2–2½ in. long, ½in. wide, or less, green, serrate on both edges, produced in 2 vertical ranks. Origin uncertain.—An interesting and beautiful species, the distichous arrangement of the lvs. lending a distinct and unusual character.

EE. *Arrangement of lvs. not distichous.*

5. **B. pygmæa**, Miq. Height ½–1 ft.: sts. very slender, purple, much branched; nodes prominent, with a waxy glaucous band: lvs. 3–4 in. long, about ½in. wide, serrate, pubescent, bright green above, glaucous beneath. Japan.—The smallest of the bamboos, and remarkably hardy. It is especially valuable as an undergrowth, quickly making a carpet in wild places; but its rampant growth will quickly outgrow close quarters.

6. **A. pùmila,** Mitford (*B. pùmila,* Hort.). Height 1–2 ft.: sts. very slender, purplish, white-waxy below the nodes: lvs. 4–5 in. long, ¾in. or less wide, minutely pubescent, bright green.—Much rarer than *B. Veitchii,* dwarfer, the sts. merely purplish, the lvs. shorter and narrower. The lvs. are a darker green than in *A. humilis,* shorter, narrower, and taper less gradually; nodes less well defined, but having a waxy bloom; internodes about 2½in. long.



457. Arundinaria nitida. (×⅛)

7. **A. hùmilis,** Mitford (*A. Fórtunei* var. *víridis,* Hort.). Height 2–3 ft.: branches in 2's and 3's, long in proportion to the sts.: lvs. 4–6 in. long, the largest about ⅞in. wide, pale green: internodes 2–5 in. long. Japan.—A rare and pretty plant, liable to confusion with *A. pumila,* but the sts. lack the waxy bloom of that species.

DD. *Plants taller than in* D, *usually in excess of 3 ft.*

E. *Sts. hollow, cylindrical, or nearly so.*

F. *Culms purple, or purplish.*

8. **A. nítida,** Mitford. Fig. 457. Height 6–10 ft.: sts. slender, seldom exceeding a lead-pencil in thickness, black-purple in color: lvs. 2–3 in. long, ½in. wide, shining green above, pale beneath; sheaths purplish, the ligule without hairs. China. M. 73. G.C. III. 18:179; 24:211. Gn. 49, p. 388.—One of the daintiest and most attractive of the arundinarias, and exceptionally hardy. Some shade is desirable, as the lvs. are often injured by strong sun. Easily distinguished from *A. Veitchii* and *A. pumila* by the deeper color of the sts., which are almost black.

9. **B. fastuòsa,** Latour-Marliac. Height 15–20 ft.: culms marked with purple-brown: the internodes with an unusually large cavity: branches numerous, erect, giving a columnar outline to each st.: sheaths shaded with purple: lvs. 5–7 in. long, an inch or less wide, bright green above, glaucous beneath. Japan.

FF. *Culms green or golden.*

G. *Species native.*

10. **A. macrospérma,** Michx. LARGE CANE. Height 15–25 ft., with numerous, short, divergent branches: lvs. 4–8 in. or more long, ¾–1½ in. broad, smoothish or pubescent; sheaths very persistent: sts. erect, rigid, simple or sparingly branched the first year, becoming dense and leafy the second, afterwards fruiting at indefinite periods, and soon after decaying. Chiefly along river banks, Va. and Ky. southward.—Forming canebrakes, sometimes of great size and density. This and the next are the only bamboos native to the U. S. Sometimes cult. as an ornamental.

11. **A. técta,** Muhl. (*A. macrospérma* var. *suffruticòsa,* Munro). SMALL CANE. SWITCH CANE. SCOTCH CANE. Height 2–12 ft.: sts. slender: lvs. 3–6 in. long, 4–12 lines wide, roughish; sheath bearded at the throat. Swamps and moist soil, Md. and S. Ind. southward.—A form, perhaps specifically distinct, which may be known as var. **decídua,** common in W. N. C., has the peculiarity of dropping its lvs. every autumn, and passing the winter in a leafless state. The foliage of this deciduous cane turns yellow in autumn, drops, and in early spring the culms resume their verdure.

GG. *Species not native to the U. S.*

H. *Branches borne singly in the axils.*

12. **A. japónica,** Sieb. & Zucc. (*B. Metáke,* Sieb.). Fig. 458. Height 5–10 ft.: lvs. 4–8 in. or more in length, 1–2 in. wide, smooth and shining on the upper surface, below whitened and finely pubescent; sheaths conspicuous. Japan. M. 1. G.C. III. 15:239; 18:185.—The commonest of the hardy bamboos, and readily distinguished from other tall-growing kinds of arundinarias by the large, broad lvs. and by the broad, persistent sheaths which almost permanently enwrap the canes. From *A. Simonii* it differs by the bud being a simple flattish scale, instead of a complex scaly one, and also by the less amount of waxy bloom on the sts. Particularly recommended for cities.

HH. *Branches borne in dense, semi-verticillate clusters.*

13. **A. Símonii,** A. & C. Rivière (*B. Símonii,* Carr. *B. víridi-striàta,* Hort. *A.* and *B. Narihìra,* Hort.). Height 10–20 ft.: lvs. 6–10 in. or more in length, usually less than an inch wide, sometimes striped with white, tapering to a long, fine point; mid-vein glaucous on one side toward the apex, green on the other. Himalayas, China and Japan. G.C. III. 15:301; 18:181.—A silver-variegated form is sometimes known as *B. Maximowíczii,* Hort., and *B. plicàta,* Hort. B.M. 7146.—One of the tallest of the arundinarias. Very late in starting into growth. It flowers quite frequently, and does not die down entirely after blooming, as some kinds do. Resistent to drought, hardy and ultimately very vigorous and handsome.

14. **A. Hìndsii,** Munro (*B. erécta,* Hort.). Height 6–10 ft.: culms straight, the branches appearing as if whorled: lvs. upright at first, varying in length up to 9 in., and about ⅝in. wide; the veins conspicuously tessellated: internodes 3–7 in. long, waxy-white; sheaths with a few hairs, long persistent. Japan.—The erect habit of

458. Arundinaria japonica. (×⅛)

growth is very pronounced, and it spreads with marked rapidity.

EE. *Sts. either solid or quadrangular.*

15. **B. quadrangulàris,** Fenzi. Sts. square, especially in older plants, 20–30 ft. tall: lvs. deep green, serrate, 6–7 in. long, about 1 in. wide, the tessellation minute. China and Japan.—A wide-spreading species, when established, and one possessing considerable hardiness. New growth is produced mostly in late summer and autumn.

16. **A. marmòrea,** Franceschi (*B. marmòrea,* Mitford). Height 3–5 ft.: sts. slender, cylindrical, without a cavity: sheaths purple, marbled with gray: nodes unusually prominent, purple, with the under side bright green: internodes short, usually 1–2 in. long: lvs. 3–5 in. long, about ½in. wide, abruptly and sharply pointed at the apex. Japan.—In cult. for several years in Calif.

CC. *Foliage variegated.*

D. *Plants low, usually 1–3 ft. in height.*

17. **A. Fórtunei,** A. & C. Rivière (*B. Fórtunei,* Van Houtte, and var. *variegàta,* Hort.). Fig. 459. Height 1–3 ft.: lvs. 4–5 in. long, ½–¾in. wide, beautifully striped with white. Japan. F.S. 15:1535.—Sometimes loses its lvs. in severe winters, but quickly recovers in spring. The internodes are rarely more than an inch long. Var. *aùrea,* Hort., with yellow variegation, is *A. auricoma.* Var. *víridis,* Hort.=*A. humilis.* An old favorite. Rhizomes very active, requiring considerable space.

18. **A. aurícoma,** Mitford (*A.* and *B. Fórtunei* var. *aùrea,* Hort.). Height 2–3 ft.: lvs. 4–6 in. long, about an inch wide, brilliantly variegated with yellow, velvety pubescent on the lower surface, serrate, with the teeth more pronounced on one side: sts. purple: nodes 3–5 in. apart. Japan.—An exceedingly beautiful and meritorious ornamental of striking character.

19. **B. angustifòlia,** Mitford (*B. Vilmorínii,* Hort.). Height about 1 ft.: sts. slender, purplish or light green, with prominent nodes: lvs. 2–4 in. long, about ¼in. wide, serrate, frequently variegated with white. Japan. —A dainty species, soon forming attractive clumps.

DD. *Plants taller than in* D, *usually in excess of 3 ft.* (*See also under No. 13 for A. Simonii.*)

20. **A. chrysántha,** Mitford (*B. chrysántha,* Hort.). Height 3–5 ft.: lvs. 5–7 in. long, 1 in. or less wide, nearly smooth, more or less variegated with yellow. Japan.—Not so brilliantly colored as *A. auricoma,* from which it may be readily distinguished by the prominent ribs and absence of the soft velvety pubescence from the lower surface of the lvs.

AA. *Internodes flattened on one side: sheaths early deciduous.*

B. *Sts. black or brown.*

21. **P. nìgra,** Munro (*B. nìgra,* Lodd.). BLACK BAMBOO. Height 10–20 ft.: sts. green at first, but changing to black the second year: nodes conspicuous, the upper rim nearly black, the lower edged with white: lvs. very thin, 2–6 in. long, 6–10 lines broad. China and Japan. M. 142, and frontispiece. G.C. III. 15:369; 18:185. R.B. 23, p. 268. B.M. 7994.—One of the most popular of the bamboos, markedly hardy and distinct. Var. **punctàta,** Hort., has yellowish sts. spotted with brownish black.

22. **P. violéscens,** A. & C. Rivière (*B. violéscens,* Carr.). Height 10–20 ft.: sts. violet, almost black the first few months, changing the second year to a dingy yellow or brown: lvs. variable in size, 2–6 in. long, ½–1½ in. wide, the larger lvs. borne on young shoots or lower branches; they are sharply serrate, and have a well-defined purplish petiole. China and Japan.

BB. *Sts. striped with yellow and green.*

23. **P. Castillònis,** Hort. (*B. Castillònis,* Hort.). Height 10–20 ft. or more: sts. zigzag, striped golden yellow and green, the colors alternating at the nodes: lvs. sparingly striped with yellowish white, variable in size, usually 3–6 in. long, ¾–1½ in. wide, serrate, the teeth being especially prominent on one edge: lf.-sheaths topped by a whorl of dark brown or purple hairs. Japan. —Both beautiful and uncommon.

BBB. *Sts. green, yellow, or yellowish.*

C. *Plants tall, i.e., more than 5 ft. high.*

D. *The internodes very short at the base of the culms.*

24. **P. aùrea,** A. & C. Rivière (*B. aùrea,* Hort.). Height 10–15 ft.: sts. yellowish, often brilliant in color, the internodes at the base remarkably short: lvs. narrowed from near the base to the apex, minutely and regularly serrate on only one border, usually 2–4 in. long and ¾in. wide, but variable, light green, glaucous beneath; sheaths deciduous, marked with purple. China and Japan. Gn. 8:206. A.F. 5:41.—Easily recognized by the very short nodes at the base of the culms.

DD. *The internodes at the base of the culms not congested.*

E. *Outline of sts. not conspicuously zigzag.*

25. **P. mìtis,** A. & C. Rivière (*B. mìtis,* Hort., not Poir.). Height 20 or more ft., and said to attain 60 ft. in its native soil: sts. deep green at first, eventually yellow: internodes at the base not conspicuously short: lvs. variable, usually 2–4 in. long and ¾in. wide, light green, serrate on only one border; sheaths deciduous, marked with purple. China and Japan. Gn. 17:44.—Readily distinguished from *P. aurea* by the long internodes at the base of the culms.

459. Arundinaria Fortunei. (×⅛)

26. **P. Quílioi,** A. & C. Rivière (*B. Quílioi,* Hort. *B. Mazélii,* Hort.). Height 20 or more ft., and under favorable conditions up to 70 ft.: sts. arched, green or yellowish, bearing unusually long branches: lvs. remarkably large and broad, the largest 8 in. long, 1¾ in. wide, conspicuously serrate on one edge, dark green, often spotted with brown, very glaucous beneath: lf.-sheaths pinkish brown, deeply mottled with purple spots. China and Japan.—Rare and unusually attractive.

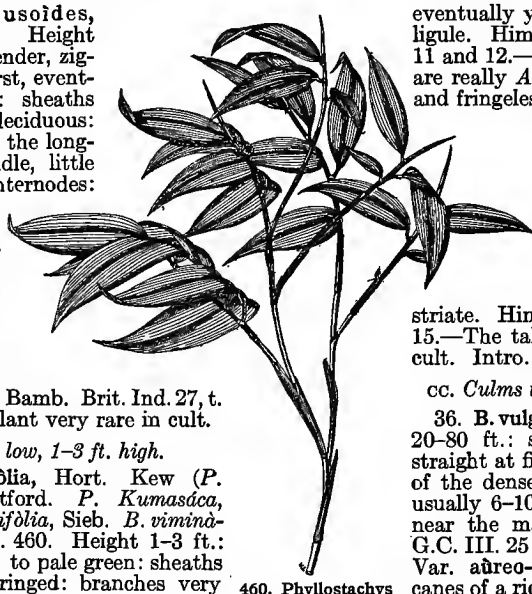
27. **P. Henònis,** Mitford (*B. Henònis,* Hort.). Height 10–15 ft.: sts. arched, bright green, eventually yellowish, the surface slightly roughened: sheaths yellow-brown, early deciduous: lvs. 2–3 in. long, a little under ½in. broad, narrowed below the middle to the base, long-attenuate at the apex, bright green; lf.-sheaths often purplish, the ligule fringed with purple hairs: internodes 5–6 in. long near the base and middle of the culm, grooved with a double furrow. Japan.—Wonderfully graceful and eminently hardy.

EE. *Outline of sts. conspicuously zigzag.*

28. **P. víridi-glaucéscens,** A. & C. Rivière (*B. víridi-glaucéscens,* Carr.). Height 20 or more ft., and under favorable conditions up to 60 ft.: sts. zigzag, arched,

bright green at first, fading as they ripen to a dingy yellow: sheaths early deciduous, the ligule extended into fringed auricles: lvs. 3–4 in. long, about ½in. wide or a little more, bright green above, whitened below. China and Japan. Gn. 7:279. G.C. III. 15:433; 18:183.—Frequent in cult. and very hardy.

29. **P. bambusoïdes,** Sieb. & Zucc. Height 6–10 ft.: sts. slender, zigzag, green at first, eventually yellowish: sheaths purplish, early deciduous: branches in 3's, the longest in the middle, little longer than the internodes: lvs. variable, 5–7 in. long, 1 in. or less wide, serrate, the teeth especially sharp on one edge, bright green, pale beneath. China and Japan. Gamble, Bamb. Brit. Ind. 27, t. 27.—The true plant very rare in cult.



460. Phyllostachys ruscifolia. (×1/15)

cc. *Plants low, 1–3 ft. high.*

30. **P. ruscifòlia,** Hort. Kew (*P. Kumasáca,* Mitford. *P. Kumasáca,* Munro. *B. ruscifòlia,* Sieb. *B. viminàlis,* Hort.). Fig. 460. Height 1–3 ft.: sts. zigzag, dark to pale green: sheaths purple, much fringed: branches very short, not more than 1 or 2 in. long, in 3's and 4's: lvs. 2–3 in. long, about 1 in. wide, ovate in outline. Japan. G.C. III. 15:369; 18:189.—The sts. are almost solid, the tube being exceedingly small. Dwarfest species of Phyllostachys.

SECTION II. *Venation essentially striate, i.e., the veins running in parallel lines from the base to the apex, cross veins obsolete or obscure, but usually with a number of interposed pellucid dots. (Embraces the less hardy types of bamboos, 31–41.)*

A. *Sts. hollow, not spiny.*

B. *Lvs. averaging not more than 3 in. long.*

31. **A. nóbilis,** Mitford. Height 15–25 ft.: lvs. 2–3 in. long, usually less than ½in. wide, bright green, borne on short, purple petioles, striate-veined: sts. yellow-green, with purple-brown nodes. Probably a native of China.—A large and graceful species intro. into Calif. by Franceschi in 1896. One of the hardiest of the arundinarias with striated lvs.

32. **A. débilis,** Thwaites. Height probably 5–10 ft.: sts. clustered, much branched, the nodes 2–6 in. apart, yellowish: lvs. 1–3 in. long, ⅛in. or less wide, striate-veined. High mts. of Ceylon and the Philippines. Gamble, Bamb. Brit. Ind. 7, t. 6.—Intro. in Calif. and offered in 1910 by the Montarioso Nursery. The character of the venation would seem to imply only moderate hardiness.

BB. *Lvs. averaging not more than 6 in. long.*

33. **A. Fálconeri,** Benth. (*T. Fálconeri,* Hook. f. *B. grácilis,* Hort., not Wall.). Height 10–15 ft.: sts. slender, bright green when young, yellow when old, the internodes sometimes white-waxy: lvs. thin, 3–4 in. long, about ½in. wide, striate-veined. Himalayas. Gamble, Bamb. Brit. Ind. 20, t. 18. B.M. 7947.—Not very hardy. The lf.-sheaths are smooth, cut short at the top, without a fringe, and with an elongated ligule; while *A. falcata* has very downy lf.-sheaths, fringed with long hairs at the intersection with the lf. The serrations of the lf.-edges are more pronounced in *A. Falconeri,* especially on one side.

34. **A. falcàta,** Nees (*B. falcàta,* Hort.). Height 10–20 ft.: lvs. 4–6 in. long, about ½in. wide, light green, striate-veined: sts. slender, not exceeding ½in. diam., covered with a bluish white-waxy coating when young, eventually yellow-green: sheaths downy, ciliate at the ligule. Himalayas. Gamble, Bamb. Brit. Ind. 12, t. 11 and 12.—A great many plants cult. under this name are really *A. Falconeri,* a species with smooth sheaths and fringeless ligules. Requires a mild climate.

BBB. *Lvs. averaging more than 6 in. long.*

C. *Culms 15–25 ft. tall, reddish brown at maturity.*

35. **A. Hookeriàna,** Munro. Height 15–25 ft.: culms glaucous green when young, turning reddish brown with age: nodes prominent, with a bluish ring: lvs. 6–10 in. long, ½–1½ in. wide, the venation striate. Himalayas. Gamble, Bamb. Brit. Ind. 17, t. 15.—The tallest and largest species of arundinaria in cult. Intro. in Calif. by Franceschi. Not very hardy.

CC. *Culms taller; giant species: sts. green or yellowish.*

36. **B. vulgàris,** Schrad. FEATHERY BAMBOO. Height 20–80 ft.: sts. bright green, 4 in. diam., or more, straight at first, eventually much arched by the weight of the dense foliage: branches numerous, striate: lvs. usually 6–10 in. long, 8–15 lines wide, rough on and near the margins and on the lower surface. India. G.C. III. 25:390. Gamble, Bamb. Brit. Ind. 44, t. 49. Var. **aùreo-variegàta,** Hort., GOLDEN BAMBOO, has canes of a rich golden yellow color, penciled with green. —Will stand but slight frost.

37. **D. Hámiltonii,** Nees & Arn. Height up to 80 ft.: sts. 4–7 in. diam., much branched above, pubescent with white hairs when young: internodes 12–20 in. long: lvs. variable, sometimes 15 in. long, 2½ in. wide, finely serrate; midrib narrow, with 6–17 nerves on either side, the nervules chiefly of pellucid glands. Himalayas. Gamble, Bamb. Brit. Ind. 85, t. 74.—The lower branches usually seated on woody knobs. Promises to become an important member of the tall bamboos in S. Calif.

38. **D. latiflòrus,** Munro. Height 60–70 ft.: sts. erect and remarkably straight, 4–5 in. diam., with a large cavity: lvs. 7–10 in. long, 1–2 in. broad, long-acuminate, deep green, borne on short petioles; midrib prominent, with about 9 nerves on either side, the transverse nervules lacking or obscure. Formosa, Burma, Cochin China. Gamble, Bamb. Brit. Ind. 131, t. 117. Munro, Trans. Linn. Soc. 26:152, t. 6.—Considered one of the best of the giant bamboos in S. Calif.

461. Bambusa arundinacea. (×⅛)

39. **D. membranàceus,** Munro. Height 60–70 ft.: sts. white-

powdery when young, smooth and bright green when older, 1–5 in. diam.: nodes prominent: internodes 9–20 in. long: sheaths with waved, hairy auricles: lvs. 5–10 in. long, ½–¾in. wide, deep green above, pale beneath, slightly hispid. Burma, India. Gamble, Bamb. Brit. Ind. 81, t. 71.—Requires a warm, protected situation to attain full development. Intro. into Calif. in 1895 by Franceschi.

aa. *Sts. either solid or spiny.*

40. **B. arundinàcea,** Retz. Fig. 461. A majestic species, often attaining a height of more than 40–60 ft.: sts. produced in dense clumps, at first green and shining, zigzag in outline, eventually straight and golden in color: branches, especially the lower, more or less spiny: lvs. 4–8 in. long, ½in. or a little more wide, nearly glabrous; sheaths persistent: fls. produced at long intervals, and after perfecting seeds, the plants die. India. Gamble, Bamb. Brit. Ind. 51, t. 48.

41. **D. strictus,** Nees. Called MALE BAMBOO, on account of the solid character of the culms. Height 20–50 ft.: sts. 1–3 in. diam., solid or nearly so, glaucous green when young, yellowish when mature: nodes swollen: internodes 10–15 in.: branches long and slender, leafy: lvs. 4–10 in. long, up to 1¼ in. wide, softhairy, at least when young, narrowed from near the base to the tip, the apex usually twisted; midrib prominent, with 3–6 nerves on either side, the nervules chiefly of interposed pellucid glands. India, Burma. Gamble, Bamb. Brit. Ind. 78, t. 68 and 69.

B. agréstis, Poir. India, Cochin China. Adv. by Yokohoma Nurs. Co.—*B. Alphónse Kúrri,* Hort. A variegated form of B. nana, Roxbg. Young sts. striped with white and pink, older sts. yellow with broad green stripes. Tender.—*A. ánceps,* Mitford. Similar to A. nitida, but mature sts. yellow-green or brown, and lf.-sheaths fringed with white hairs. Native of the Himalayas, at elevations between 9,000–10,000 ft.—"*B. argéntea.* Grows 25–35 ft. high; the dense masses of beautiful green foliage, glaucous underneath, and the hundreds of slender culms growing close together, the exterior ones bending over to all sides, combine to make this bamboo indescribably beautiful." H. Nehrling, Fla.—"*B. argéntea* var. *vittàta,* the variegated bamboo or the blue bamboo of gardens, the taiho-chiku of the Japanese, who have grown this from time immemorial in pots, is one of the most satisfactory in Fla.; it attains the size of B. argentea, but its lvs. are still more blue on the under side and altogether smaller and more delicate; they are striped and edged with white." Nehrling.—*A. aristàta,* Gamble. Sts. 5 ft., purplish brown: lvs. 4 in. long, ½in. or less wide, narrowed to an acute apex, venation tessellate. Himalayas, where it thrives at elevations of 11,000 ft.—*B. aùreo-striàta,* Regel. Japan.—*P. Boryàna,* Hort. By some authorities considered to be a form of P. nigra, but the culms are of a dull yellow color when mature, splashed here and there with purple-brown blotches, and the branches are much longer in proportion to the culms. China and Japan.—*P. flexuòsa,* A. & C. Rivière. Culms 6–10 ft., dull greenish yellow when mature: lvs. similar to those of P. viridi-glaucescens: ligules of the culm-sheaths without auricles. A comparatively small and compact ornamental. China.—*A. fòliis-variegàtis,* Hort., is presumably A. Fortunei, the commonest low-growing, variegated arundinaria.—"*B. grácilis.* This most beautiful small species used to be grown in gardens under the name of A. falcata: the lvs. are very small, arranged in a distichous way on both sides of the twigs; they have a fine emerald-green color: sts. thin and slender, the whole plant not growing taller than 10–12 ft." Nehrling.—*P. heterocỳcla,* Carr. A curious plant, the lower internodes of which are obliquely and alternately arranged like the scales of a tortoise, and for this reason called the "tortoise-shell bamboo." At about 1–3 ft. from the ground the nodes lose this peculiar character, and assume a regularity as in other species. In other respects this interesting bamboo does not differ much from P. mitis, or P. aurea. Japan.—*A. Khasiàna,* Munro. A Himalayan species with black sts., allied to A. falcata. The name, however, has been misapplied to A. nitida and A. nobilis, and the true species is probably not in cult. in the U. S.—*B. Laydékeri,* Hort. Height 3–8 ft.: sts. green with a tinge of purple, verticillately branched above, the branches relatively long: lvs. 4–6 in. long, ½in. or less wide, dark green, somewhat mottled in appearance. China and Japan.—"*B. macrocálmis.* Received about 15 years ago directly from Japan under the name of taisan-chiku. It is a veritable giant, growing 50–75 ft. high with large dark green lvs. and thick culms, first green, then black; old culms have a gray color: in stature this is one of the noblest of all the bamboos, and it is perfectly hardy; the sts. spring straight out of the soil like spears and when they have fully developed they bend over to all sides at their tops, so that the entire plant from a distance looks like a gigantic sheaf." Nehrling.—*P. marliàcea,* Mitford. Wrinkled Bamboo. Similar to P. Quilioi, but the internodes at the base are very close together, not more than 1–2 in. apart, much wrinkled. Japan.—*P. nigro-punctàta,* Hort. Probably a variety of P. nigra, under which it appears in the classified descriptions above.—"*B. nùtans.* A most exquisite bamboo grown for many years under the name of Dendrocalamus strictus, which is a very different plant; grows 35–40 ft. high with a very dense growth of small green lvs, the green having a shade of blue in it; the sts. hang over to all sides, forming beautiful arches; tender; a most exquisite plant to grow on lawns or on the edge of lakes, or in the foreground of deep green magnolias." Nehrling.—*B. orientàlis,* Nees. Adv. by Franceschi, Santa Barbara, Calif., who regards it as a form of B. arundinacea, with lvs. larger and velvety to the touch. It forms clumps quickly. E. India.—*A. racemòsa,* Munro. A native of the Himalayas, growing at high altitudes: height up to 15 ft., the culms brown, very thick in proportion to height; the long and narrow lvs. are conspicuously teasellated.—"*B. scriptòria.* A small species not growing over 6–8 ft. high, forming fine dense clumps: lvs. small, green, underneath glaucous; particularly valuable for small gardens." Nehrling.—*A. spathiflòra,* Trin. Height 10–20 ft., the culms yellowish or nearly brown, slender and much branched: lvs. teasellated, 2–3 in. long, about ¼in. wide, acutely pointed, thin in texture. Himalayas, at altitudes of 7,000–10,000 ft.—*B. striàta,* Lodd. Height 4–5 ft.: sts. striped yellow and green, as thick as the thumb; internodes 4–6 in. long: lvs. 6–8 in. long, ¾–1 in. broad. China. B.M. 6079, which shows a flowering specimen with conspicuous anthers, red-purple at first, and fading to lilac. Not described by Mitford. Formerly sold by Yokohoma Nurs. Co.—*B. striatifòlia* var. *aùrea,* Hort., an abandoned trade name never recognized by botanists.—*B. stricta,* Hort., an old trade name probably not B. stricta, Roxbg.—*P. sulphùrea,* A. & C. Rivière. Height 10–15 ft., seemingly intermediate between P. mitis and P. aurea. It is less tall than the former, and the sts. are more brightly colored than in the latter species. Japan.—*B. Thouársii,* Kunth. A doubtful species, considered by some botanists to be only a form of the widespread B. vulgaris; but, according to Franceschi, at least horticulturally distinct. Height 50–60 ft., with a diam. of culm of 4–5 in. Intermediate in outline between the erect-growing D. latiflorus, and the spreading or horizontally inclined B. vulgaris. Intro. into Calif. some 25 years ago, and in recent years reintro. by the U. S. Dept. of Agric. from S. France, where it had come from Algiers 40–45 years ago.—*B. Túlda,* Roxbg. Height up to 70 ft., the culms 4–5 in. diam., and of a remarkable gray-green color: lvs. very glaucous on the lower surface. Recently intro. by the U. S. Dept. of Agric. Bengal and Burma. Gamble, Bamb. Brit. Ind. 30, t. 29.—*B. variegàta,* Sieb.=A. Fortunei.—*B. verticillàta,* Hort., Franceschi. Height 15–20 ft.: sts. orange-yellow: lvs. in whorls, striped white.

Among the recent introductions of bamboos by the United States Department of Agriculture, representing two genera of much interest and rarity to the United States, are the following:

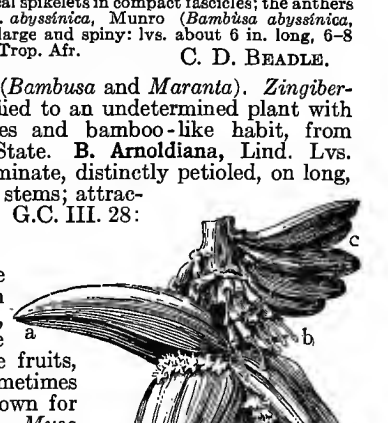
CHUSQUÈA. A genus belonging to the subtribe Arundinarieæ, of tall, shrubby or climbing plants with the flowering branches in clusters at the joints, and comparatively small lvs. and spikelets. W. Indies and S. Amer., chiefly in the Andes.—*C. bambusoides,* Hack. A large species with small panicles exceeded by the crowded blades, 1 in. wide and about 6 in. long. Native of Brazil.—*C. quila,* Kunth. A freely branching arborescent species with numerous open panicles and distant lvs. scarcely ½in. wide. Native of Chile.—*C. valdivénsis,* Desv., of Chile, is a slender climbing species with naked sts. and numerous fascicled leafy flowering branches, the lvs. 3–4 in. long.—*C. abietifòlia,* Griseb. A climbing species with dense tufts of short branches with lvs. less than 2 in. long and about ½in. wide. Native of the W. Indies.

OXYTENANTHÈRA. A genus of the subtribe Eubambuseæ, of tall, shrubby plants from the E. Indies and Afr., characterized by long, cylindrical or conical spikelets in compact fascicles; the anthers ending in a bristle.—*O. abyssínica,* Munro (*Bambùsa abyssínica,* Rich.). Infl. capitate, large and spiny: lvs. about 6 in. long, 6–8 lines broad. Native of Trop. Afr.

C. D. BEADLE.

BAMBURÁNTA (*Bambusa* and *Maranta*). *Zingiberàceæ.* A name applied to an undetermined plant with maranta-like leaves and bamboo-like habit, from the Congo Free State. **B. Arnoldiana,** Lind. Lvs. broadly ovate, acuminate, distinctly petioled, on long, spreading, graceful stems; attractive as a pot-plant. G.C. III. 28: 313 (1900).

BANANA, a name applied to certain species of Musa, particularly to those that produce edible fruits, although it is sometimes used for species grown for ornament, as for *Musa Ensete.* There are three groups of edible bananas: the common banana, eaten raw, *Musa sapientum;* the plantain, fruits to be cooked, *M. paradisiaca;* dwarf, with edible fruits, *M. Cavendishii.* The first two are probably forms of



462. Tip of flower-cluster of banana.

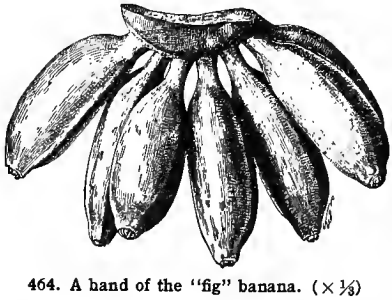
one species, and the botanical nomenclature is confused. Some species produce fiber. Consult *Abaca* and *Musa*.

The banana plant is a great perennial herb. It grows 10 to even 30 feet tall, and produces a bunch of fruit, and the stalk then dies or becomes weak; in the meantime, suckers have arisen from the rootstock to take its place. The peculiar flower-bearing of the banana is shown in Fig. 462, which illustrates the tip of a flower-cluster. This cluster may be likened to a giant elongating bud, with large, tightly overlapping scales or bracts. Three of these bracts are shown at *a a a*, in different stages of the flowering. As they rise or open, the flowers below them expand. The bracts soon fall. The flowers soon shed their envelopes, but the styles, *b*, persist for a time. The ovaries soon swell into bananas, *c*. The bracts are royal purple and showy.

463. Plantain banana. ($\times\frac{1}{6}$)

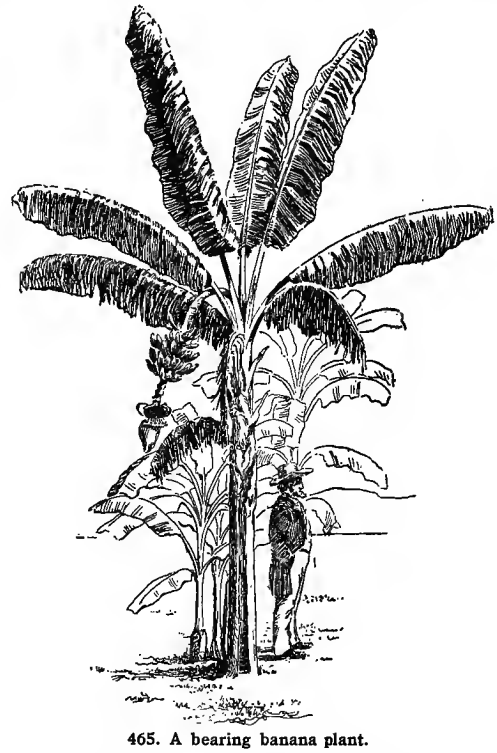
The banana has come to be one of the most popular fruits in North America, due to the cheapness of its cultivation and transportation, ease of handling, long-keeping qualities, and adaptability to many uses. The source of supply is mostly Jamaica, Costa Rica, Cuba, Honduras, and latterly the northern shores of Colombia. In the tropics, the ordinary bananas are cooked and used as a vegetable rather more than as a fruit to be eaten from the hand. The plantains, which are coarser and harder fruits and thicker, are always cooked. A form of cooking banana used in parts of tropical America is shown in Fig. 463. Of the banana itself there are many varieties. The common large fruit in northern markets is the Martinique, Jamaica, Gros Michel or Bluefields. A red variety, the Baraçoa or Red Jamaica, is sometimes seen. In the tropics, various very small forms are grown for local consumption. These are fragile and do not keep long, and are rarely seen in the markets North. One of them, known as the "fig" in Trinidad, is shown in Fig. 464; the fruits are about 3 inches long. The dwarf or Cavendish banana is grown extensively in the Canary Islands, and apparently also in Bermuda; and it is not uncommon as an ornamental plant in conservatories.

It is said that the banana was first imported into the United States in 1804 by Captain John N. Chester of the schooner Reynard, the lot consisting of thirty bunches. The first full cargo is said to have been 1,500 bunches brought to New York in 1830 on the schooner Harriet Smith, chartered by John Pearsall of the firm of J. & T. Pearsall. Two or three cargoes would appear each year, until about 1857 William C. Bliss entered the banana-importing business, securing his supply from Baraçoa, Cuba, and taking the trade to Boston. In 1869, he secured a small cargo from Jamaica. In recent years, the Jamaica-United States banana trade has assumed very large proportions.



464. A hand of the "fig" banana. ($\times\frac{1}{3}$)

In the United States, there is little commercial cultivation of bananas, since the frostless zone is narrow and the fruit can be grown so much more cheaply in Central America and the West Indies. Small banana plantations are common in southern Florida, however, and even as far north as Jacksonville. They are also grown in extreme southern Louisiana, and southwestward to the Pacific coast. The plants will endure a slight frost without injury. A frost of five or six degrees will kill the leaves, but if the plants are nearly full grown at the time, new foliage may appear and fruit may form. If the entire top is killed, new suckers will spring up and bear fruit the following year. A stalk, or trunk, bears but once; but the new sprouts which arise from the roots of the same plant continue the fruit-bearing. A strong sprout should bear when twelve to eighteen months old (from two to three years in hothouses).



465. A bearing banana plant.

The plantation will, therefore, continue to bear for many years. A bearing stalk, as grown in southern California, is shown in Fig. 465.

The species mostly in demand for fruiting seldom or never produce seeds, and naturally increase by suckers. The suckers are most readily separated from the parent rootstock by a spade. This is a slow process of increase, but the suckers so produced make large and vigorous plants. A quicker method of propagation is to cut the entire rootstock into small, wedge-shaped pieces, leaving the outer surface of the root about 1 by 2 inches in size, planting in light, moist soil, with the point of the wedge down and the outer surface but slightly covered. The best material for covering these small pieces is fine peat, old leaf-mold, mixed moss and sand, or other light material that is easily kept moist. The beds so planted should be in full open sunshine if in a tropical climate, or given bottom heat and plenty of light if in the plant-house. The small plants from root-cuttings should not be allowed to remain in the original bed longer than is necessary to mature one or two leaves, as that treatment would stunt them.

The textile and ornamental species, also, may be increased by the above process, but as these species usually produce seeds freely, seedlings can be more quickly grown, and with less trouble. The seeds of bananas should be sown as fresh as possible, treating them the same as recommended for root-cuttings. As soon as the seedlings show their first leaves, they should be transplanted into well-prepared beds of rich, moist soil, or potted off and plunged into slight bottom heat, as the needs of the grower or his location may demand. Both seedlings and root-cuttings should have proper transplanting, sufficient room and rich soil, as a rapid, unchecked growth gives the best and quickest results.

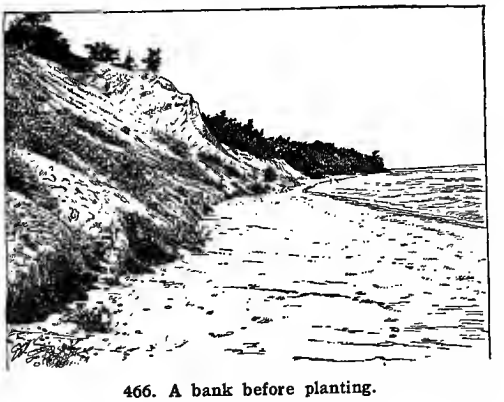
In the West Indies, Central America and Mexico, bananas are raised for export to the United States and Canada. The site chosen is usually a level plain in the lowlands, near the coast, or in valleys among the hills, where the rainfall or artificial moisture is sufficient. For distant shipping, bunches of fruit are cut with "machetes" or knives, after they reach their full size and are almost mature, but quite green in color. Ripening is effected during shipment in warm weather, and by storing in dark, artificially heated rooms during cold weather. Banana flour is a valuable product of ripe bananas prepared among the plantations in the tropics. It is nutritious, and has an increasing demand and use as human food. A recently invented process of drying ripe bananas has been found very successful, and the industry promises to be of vast importance as the marketable article finds ready sale. Further details of the growing of the commercial crop in the tropics may be found in Cyclo. Amer. Agric., Vol. II, p. 199.

E. N. REASONER.
L. H. B.

BANEBERRY: *Actæa.*

BANKS. The means of holding and planting banks and steep surfaces is one of the perplexities of the horticulturist and landscape designer. The banks to be considered may be defined as very steep earth slopes with a bare, shifting surface, requiring protection and planting, or a surface covered with natural vegetation. Figs. 466–469.

Low banks, either curved or rigidly formal, usually enter into symmetrical designs of the elaborately finished surroundings of a fine home. Usually they are

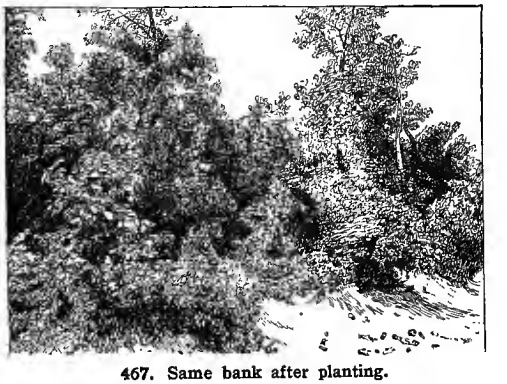


466. A bank before planting.

placed to outline or to inclose parts of a design, or to decrease or increase the apparent height of a building or other structure, or of a garden compartment.

Protection.

One problem to be solved is the protection of sea, lake, river, and small stream banks and bluffs against the sliding of the soil, due to waves or along-shore currents in sea or lakes and to running water, especially floods, in stream beds. Such water-action, cutting under the base of a bank, causes the soil above to slide down. On lake and sea shores, jetties built from the bluff-base into the water will check an eroding marginal current, make it drop its load of silt, and extend the shore. In many positions willows, planted close together in a wide band on the beach or at the bluff-base, will accumulate and fill with roots the soil that



467. Same bank after planting.

is washed down and blown in, and thus create a water-resisting barrier. Along salt water, plantations of the sea-beach grass, *Ammophila arenaria,* and the shrubby *Baccharis halimifolia and Iva frutescens* are serviceable; and far South, the mangrove may be planted on outermost sea-edges.

Another bank trouble is soil-seepage water coming to the surface part way up the slope and making mud patches that slide down and cause the soil above to cave away. Usually this sloughing is at an impervious soil layer at some feet below the surface, to which the water passes, then finds its way out to the bank-face. If this water is at fixed spring-like points, a tile drain laid in porous material about 3 or 4 feet deep and directly down the bank to a concrete anchor at the outlet opening will usually take off the water that causes sliding. If the seepage is all along the face of the bank, it may be necessary to carry a drain some feet back from and parallel to the edge of the bluff-top down to and a little into the impervious soil, with tile outlets down the bank.

The surface of banks is often gullied by water running from the top down the face at frequent intervals. This may be prevented by forming a ridge or barrier at the edge of the bluff to carry the water along sodded channels to paved or piped outlets down the slope.

Sand-bluff surfaces that drift with the wind need thick plantations of plants that will grow well in sand, with a mulching of hay, leaves or litter to keep the sand in place until vegetation is established.

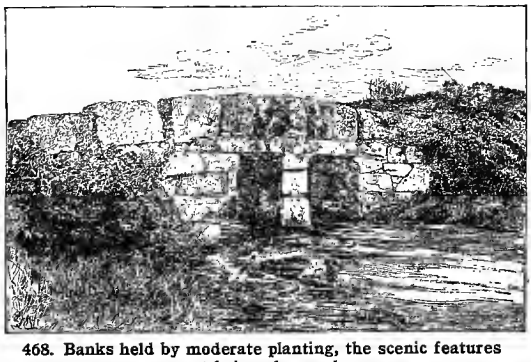
The erosion of large streams at the base of bluffs is often beyond the means of individuals to control, although persistent willow-planting along shore and planting on the slope, will often suffice. In bad banks, a riprap of stone with plants having matted roots between the stones will hold. On smaller streams, ripraps of stones or stumps, while unattractive until covered with vines, will hold banks at critical places. A continuous stone wall is not a good barrier unless it is high enough on both sides to include flood-water, and the cost of such walls is too high for most individuals.

On sliding slopes there is usually an overhanging upper edge with a short perpendicular edge just under it to be graded back. The material thus secured may be used at the foot of the bluff. When more ideal conditions are desired, the grading may be extended to give angular raw banks the graceful contours that nature's gradual rounding-down of angles will give.

Planting.

On low banks and terraces, where soil may be thoroughly prepared and well cared for, turf or any vigorous plant can be established. In elaborate garden designs, such planting is often trimmed or trained to a uniform surface or arranged to make a part of a formal pattern.

On high banks, landscape beauty of distinction may be created by the selection, arrangement and manage-



468. Banks held by moderate planting, the scenic features not being obscured.

ment of artificial plantations or the natural growth. High banks uniformly drained and graded to prevent slipping, such as railroad and reservoir slopes, may be turfed. Such treatment is not recommended in large operations in which an interesting and varied surface-cover, or a low maintenance cost, is desired. When large bluffs require many thousand plants and limitations of cost require that they be planted with little soil preparation, varieties must be selected that will grow well in the soil presented. They must be plants that can be procured in large quantities at low cost, for the bulk of the planting, and it is desirable that they have such special characteristics as underground or surface stolons or trailing stems that root strongly at frequent intervals, or stems that root at the tips. There are also varieties with very densely matted fibrous roots that hold soil well.

The following plants meet these requirements for the soils indicated:

Low evergreen plants for the sandy or gravelly soil of the North: Bearberry (*Arctostaphylos Uva-Ursii*) an ideal evergreen trailing ground-cover for sand or gravel, of which collected plants must be used that are not easily transplanted. Trailing juniper (*Juniperus communis*). Savin juniper (*Juniperus Sabina*). These three species are not procurable in large quantities at low cost, and collected plants do not transplant readily.

Low evergreen plants for good soil in shade: Evergreen spurge (*Pachysandra terminalis*), excellent for shade and hardy over a wide territory. Myrtle or large periwinkle (*Vinca major*), from Virginia south. Periwinkle (*Vinca minor*), from Pennsylvania north. The last three plants are offered by nurseries in large quantities, the latter at low cost by collectors, and collected plants transplant well. Japanese evergreen honeysuckle (*Lonicera japonica*). This climber and trailer is one of the best bank-covers in states south of New York, and it can be obtained in nurseries or from collectors in large quantities. Spring planting should be done very early.

For low deciduous trailers or medium high shrubs for nearly all soils, the tip-rooting species of blackberry, such as *Rubus canadensis*, *R. dumetorum*, *R. occidentalis*, and the species with underground stolons, such as the cultivated high-bush blackberries, and red raspberries, are serviceable and can be obtained in large quantities at low cost. Plants having a similar habit may also be thus secured, as the matrimony vine, the Indian currant, the weeping golden bell (*Forsythia suspensa*), the wild roses, (*Rosa lucida* or *R. nitida*), the staghorn sumac (*Rhus typhina*). Of low-cost trees, the common locust, soft maple, box elder, and Russian mulberry, are all suitable.

Of matted-root plants, the Japanese barberry, the hop-tree (*Ptelea trifoliata*), the European euonymus, the common buckthorn, can usually be readily procured.

Of small trees for shade, the flowering dogwood and red-bud are especially suitable and attractive from Massachusetts and New York south.

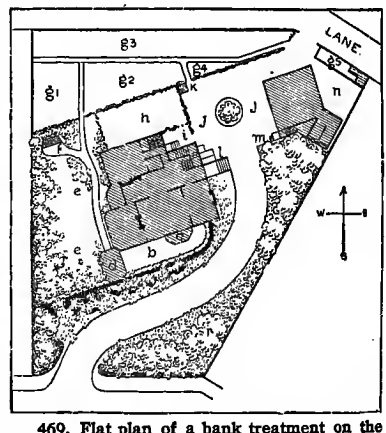
Of tall evergreen trees, the white pine is more serviceable for light soils and more easily procured; the arborvitæ and red cedar are the most available medium-height trees for average soils.

In California, the mesembryanthemums are largely used for bank-covers.

It is very desirable to establish a ground-cover of low shrubs and especially herbs under trees on banks as soon as practicable. By using hay containing wild asters, thoroughworts, blazing star, goldenrod, perennial sunflowers, and the like, for mulching young plantations, many of these plants will be introduced from seed, especially when seeds are mature. These will gradually be superseded by such shade-loving plants as ferns, violets, woodland asters, and goldenrods, especially if colonies of these plants are introduced as soon as the plantations are high enough to give shade.

Arrangement.

If it is important to retain an extended open view from the top of high banks, then high trees must be confined to the lower edge, medium-sized trees and large shrubs to the central zone, and trailing plants or low shrubs to the upper zone. If the bank is a low one, then low trees or large shrubs must be substituted for the large trees at the bottom of the bank. It is often more interesting, however, to allow the bank to be covered with tall trees and then open vistas and views through these trees by cutting branches and thinning out as they develop. Banks offer rather an unusual opportunity for the development of interesting detail in the development of the planting, because of varying conditions of moisture and soil. Such interesting details should be made accessible by trails following along the slope on easy grades that can be made at the time the bank is first graded or at later periods as the growth develops.



469. Flat plan of a bank treatment on the right of the plan; and good planting against the residence, and up a bank at the rear.

WARREN H. MANNING.

BÁNKSIA (Sir Joseph Banks, 1743–1820, famous English scientist). *Proteàceæ*. Australian evergreen shrubs or trees with handsome foliage, but not widely known in cultivation here.

Leaves variable, often deeply incised, usually dark green above, white or brown downy beneath: fls. showy, sessile, usually in pairs, spicate; spike terminal or axillary, mostly crowded within the bracts and floral lvs.,

the pistillate ones ultimately forming thick woody strobiles.—Species 46, more than 23 of which have been more or less cult. in England, but only 2 or 3 so far known here.

Propagation is difficult, and by seeds is usually an unsatisfactory method, although *B. serrata* has been grown satisfactorily from seeds. Cuttings under a bell-jar, without too much heat, root fairly well.

The following have been recently catalogued in North America; none of them has "gained a permanent foothold" in California. Several species are known in American botanic gardens.

integrifòlia, Linn. Ten to 12 ft.: lvs. 6 in. long, 1–1½ in. wide, entire, or rarely a little dentate, the upper side dark green, silvery white beneath, scattered or sometimes irregularly verticillate; spikes 3–6 in. long; perianth about 1 in. long, greenish yellow. Cav. Ic. 546. B. M. 2770. Lam. Encyc. 54.

serràta, Linn. Tree, 10–20 ft., the young branches tomentose: lvs. oblong-lanceolate, 3–6 in. long, coriaceous and deeply and regularly serrate: fls. similar to the preceding, but red. B.R. 1316 (*as B. undulata*). Cav. Ic. 539, 540.—Almost perfectly hardy in Cent. Fla.

ericifòlia, Linn. Fig. 470. Shrub or small tree, 12-14 ft.: lvs. scarcely longer than ¾in., heath-like: spikes 6–10 in. long, the yellow perianth about ¾in. long. B.M. 738. Andr. Bot. Rep., pl. 156. Cav. Ic. 538.

470. Banksia ericifolia. (×⅛)

B. latifòlia, R. Br. Stout shrub: lvs. irregularly almost spiny serrate, 4–8 in. long, 1½–3 in. wide: spikes 3–5 in. long; perianth slender, scarcely 1 in. long, greenish. B.M. 2406.—*B. prionòtes,* Lindl. Tree, 15–25 ft.: lvs. 8–11 in. long, ½–1 in. wide, pinnatifid.: spikes 3–5 in. long; perianth scarcely an inch long, villous; style rigid, incurved at the base. N. TAYLOR.

BANUCALAG: *Aleurites trisperma.*

BANYAN TREE: *Ficus indica,* and other species.

BAOBAB: *Adansonia.*

BÁPHIA (name meaning *dye*). *Leguminòsæ.* CAMWOOD. BARWOOD. Shrubs or small trees, sparingly planted far south.

Erect or climbing: lvs. 1-foliolate, exstipellate, the stipules small: fls. white or yellow, papilionaceous, fascicled or racemose; calyx short-toothed but becoming slit as the fl. opens; standard orbicular, and wings oblong or obovate, keel obtuse and slightly incurved; stamens not united: pod linear-lanceolate, acuminate, flattened.—A dozen species in Trop. Afr. and Madagascar. Sometimes grown in hothouses. Prop. by cuttings bearing lvs.

racemòsa, Hochst. Erect, 8 ft., branches glabrous: lvs. leathery, 3 in. long, oblong or nearly so, acute: fls. large in a leafy panicle; corolla much exceeding the calyx, white with purple veins on the standard: pod 2 in. long, about 2-seeded. S. Cent. Afr. and Natal. —Offered in S. Fla. L. H. B.

BAPTÍSIA (Greek, *to dye,* alluding to the coloring matter in some species). *Leguminòsæ.* FALSE INDIGO. About twenty-five erect perennial herbs of eastern North America, sometimes planted in borders and collections.

Branching herbs: lvs. alternate, mostly 3-foliolate: corolla papilionaceous, the standard not larger than the wings: calyx campanulate, the 5 teeth separate and equal or the 2 upper ones united: stamens 10, distinct: pod stalked in the calyx.—Plants usually turn black in drying.

Baptisias thrive in any ordinary soil and under common treatment, preferring free exposure to sun. Propagation is by division or seeds.

A. *Lf.-blades simple: fls. yellow.*

simplicifòlia, Croom. Branchy, 2–3 ft.: lvs. 2–4 in. long, sessile, broadly ovate and obtuse: fls. in numerous terminal racemes. Fla., in dry pine- or oak-lands.—Intro. 1891.

perfoliàta, R. Br., with small axillary fls. and broad perfoliate lvs., is occasionally planted, and is hardy as far north as Washington, but is evidently not in the trade. S. C. and Ga., on sand-hills. B.M. 3121.

AA. *Lf.-blades compound, 3-foliolate.*

B. *Fls. yellow.*

tinctòria, R. Br. WILD INDIGO. Bushy-branched, 2–4 ft., glabrous: lvs. stalked, the lfts. small, obovate or oblanceolate, and nearly or quite sessile and entire: fls. ½in. long, bright yellow, in numerous few-fld. racemes. Common in eastern states and to La. B.M. 1099. Mn. 5:81.—A kind of indigo may be extracted from this plant, and it has been used by dyers. The root and sometimes the herb are employed medicinally.

lanceolàta, Ell. About 2 ft., pubescent when young, but becoming nearly glabrous: lvs. short-stalked, the lfts. thick, lanceolate to obovate and obtuse: fls. large, dull yellow, axillary and solitary but close together near ends of branches. Pine barrens, N. C. to Fla.

BB. *Fls. blue.*

austràlis, R. Br. (*B. cærùlea,* Eaton & Wright. *B. exaltàta,* Sweet). Stout, 4–6 ft., glabrous: lvs. short-stalked; lfts. oblanceolate to oval, entire, obtuse: fls. lupine-like, indigo-blue, nearly or quite an inch long, in loose-fld., long terminal racemes. Pa., W. and S. J.H. III. 29:64; 34:511.—Handsome. Probably the best species for cult.

BBB. *Fls. white or whitish.*

álba, R. Br. Wide-branching, 1–3 ft., smooth: lvs. stalked; lfts. oblong or lanceolate, obtuse, thin, drying green: fls. white, ½in. long, in long-peduncled, elongated lateral racemes. N. C., W. and S., and extending northward. B.M. 1177.

leucántha, Torr. & Gray. Branching, more or less succulent, 2–4 ft., glabrous: lvs. stalked; lfts. obovate to oblanceolate to cuneate, very obtuse, drying black: fls. white, nearly an inch long, in loose-fld., lateral racemes. Ont. to Texas.

leucophæa, Nutt. St. stout and angled, but low and wide-branched, 1–2½ ft., hairy or nearly glabrous: lvs. short petioled; lfts. oblanceolate to obovate, stiff, drying black: fls. large and cream-colored, on slender erect pedicels, borne in 1-sided declined racemes. Mich. to Texas. B.M. 5900. Mn. 3:177. F.S. 23:2449. L. H. B.

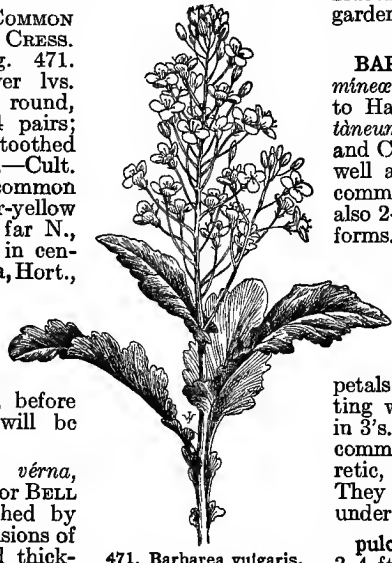
BARBACÈNIA (Barbacena, a Brazilian governor). *Amaryllidàceæ.* About 30 Brazilian plants, with scape bearing a single purple fl. Grown mostly in baskets, after the manner of many orchids. **B. purpùrea,** Hook., is occasionally seen in fine collections, but does not appear to be in the American trade. Grown in a warm, moist house. It has many scapes which are much longer than the long, grass-like, toothed, prominently keeled lvs; 1½ ft. Summer. B.M. 2777.—The genus is anomalous. It has been placed in the *Hæmodoraceæ* as well as in *Amaryllidaceæ;* and Engler & Prantl place it in the small family *Velloziaceæ.*

BARBADOS LILY: *Hippeastrum.*

BARBARÈA (from the old name, Herb of Saint Barbara). *Cruciferæ.* Hardy biennials, with yellow flowers, sometimes cultivated; allied to water-cress and horse-radish.

Branching leafy herbs: fls. small, yellow, clustered: fr. a linear cylindrical and 4-angled pod, the valves keeled.

vulgàris, R. Br. Common Winter Cress. Upland Cress. Yellow Rocket. Fig. 471. Height 10–18 in.: lower lvs. lyrate, the terminal lobe round, the lateral usually 1–4 pairs; upper lvs. obovate, cut-toothed at the base. Eu. Asia.—Cult. for salad, and also a common weed, making fields sulfur-yellow in early spring. Native far N., but apparently a settler in central states. Var. **variegàta,** Hort., lvs. splashed and mottled with yellow, is cult. as a border plant, and grows freely in rich soil. If the fls. are picked off, st. and all, before they open, the plant will be practically perennial.



471. Barbarea vulgaris.

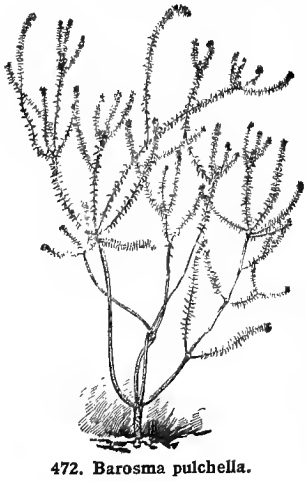
præcox, R. Br. (*B. vérna,* Asch.). Early Winter, or Bell Isle Cress. Distinguished by the more numerous divisions of the lvs. (4–8 pairs) and thickened pedicels. Slightly cult. as a winter salad, and known S. as scurvy grass. Naturalized from Eu. L. H. B.†

BARBE DE CAPUCIN: *Chicory.*

BARBERRY: *Berberis.*

BARBIÈRIA (after J. B. G. Barbier, French physician). *Leguminòsæ.* Hothouse evergreen; 1 species, from Trop. Amer. Its nearest allies familiar to the horticulturist are Indigofera and Petalostemon. It is distinguished from these allied genera by the calyx- and corolla-tubes, which are much longer than in either of them. Tender evergreen shrubs, with odd-pinnate lvs., numerous entire lfts., and awl-shaped stipules: fls. large racemose, red. Prop. by seed and by cuttings of half-ripened wood under a bell-jar, with bottom heat.

pinnàta, Baill. (*B. polyphýlla,* DC. *Galáctia pinnàta,* Pers. *Clitòria polyphýlla,* Poir.). Lfts. 9–11 pairs, elliptic-oblong, mucronate, pubescent with age: racemes few-fld., shorter than the lvs.; fls. 2 in. long. Trop. Amer.—*B. glabélla,* Hort., is probably a variety. N. Taylor.†



472. Barosma pulchella.

BARKÈRIA: *Epidendrum.*

BARLÈRIA (J. Barrelier, died 1673, French botanist). *Acanthàceæ.* Hothouse evergreen shrubs.

Fls. axillary or terminal, the calyx with 4 sepals, the 2 outer larger than the inner; corolla-tube long, its limb of 5 rounded, ovate lobes.—A genus of 150 species of tropical shrubs, mostly African, sometimes seen in fine collections of stove plants, but not offered in the American trade. Prop. by cuttings of young wood, under a bell-jar with bottom heat. **B. cristàta,** Linn., with purplish blue fls., or rarely white, in dense spikes, is sometimes used as a bedding plant. **B. strigòsa,** Willd., with subcoriaceous lvs., somewhat strigose, and large blue fls. in terminal spikes, is not uncommon in botanic garden collections.—Worthy of greater notice. N. Taylor.

BARLEY. Various kinds of *Hórdeum* of the *Gramíneæ.* Common barley is *H. satìvum,* Jess. According to Hackel, it "undoubtedly originated from *H. spontàneum,* C. Koch, which grows wild from Asia Minor and Caucasian countries to Persia and Beloochistan, as well as in Syria, Palestine, and Arabia Petræa." The common barley has a 4-rowed ear or head. There are also 2-rowed and 6-rowed races, and other well-marked forms. They are probably all domestic forms of one parent stock. For fuller treatment, see Cyclo. Amer. Agric., Vol. II, p. 202.

BARÓSMA (*heavy scent*). *Rutàceæ.* A group of 15 species of S. African heath-like shrubs. Fls. on axillary twigs; calyx 5-cleft or 5-parted; petals 5, oblong, usually subsessile; stamens 5, alternating with 5 staminoidea: lvs. mostly opposite, rarely in 3's. Some of the species furnish the buchu lvs. of commerce, which are used in medicine for their diuretic, diaphoretic, stimulant, and tonic properties. They are evergreens, and in the N. must be grown under glass. Prop. by mature-wood cuttings.

pulchélla, Bartl. & Wendl. Fig. 472. Shrubby, 3–4 ft.: lvs. scattered, ovate, with a revolute margin: fls. axillary, solitary or in pairs longer than the lf.; petals 3 times longer than the calyx. B.M. 1357 (as Diosma).—Sold by some dealers, but rare in this country.

B. fœtidíssima, Bartl. & Wendl. (Agathosma fœtidissima, Hort.). A low shrub, 2–3 ft.: lvs. ternate, a little longer than the internodes: fls. umbellate at the ends of the branches, the petals one-half to one-third longer than the calyx, white or pinkish white.—Attractive little shrub, grown in the temperate house, but evil-smelling. It often scents a whole greenhouse. N. Taylor.

BARRINGTÒNIA (Daines Barrington, English naturalist and antiquary, died 1800). Including *Stravídium. Myrtàceæ;* placed in *Lecythidàceæ* by those who keep this group as a distinct family. Evergreen broad-leaved trees, some of which are planted in the tropics for the striking foliage and flowers.

Leaves mostly large and crowded at the ends of the branches, entire or somewhat crenate: fls. large in the cult. species and striking because of the numerous long and protruding stamens which are united in a ring; calyx-tube ovoid or turbinate, lobed; petals 4 or 5; ovary inferior, 2–4-celled: fr. a fibrous berry-like or box-like structure, crowned by the calyx-limb, 1-seeded by abortion of other ovules.—About 30 species in tropical parts of Asia, Afr., and Polynesia, bearing the white or reddish fls. in spikes or racemes.

speciòsa, Forst (Figs. 473, 474), is apparently most planted in parts of the American tropics: tree wide-spread-

473. Barringtonia speciosa. (×⅛)

ing, large-boled, to 50 ft. in height: lvs. entire, obovate, sessile, shining, 12–15 in. long: fls. few in the raceme, large and showy, petals white and stamens tinted purple, the style long and prominent: fr. 4-sided (almost square in cross-section at the middle or below), 3 in. diam. at base, box-like in looks, with a single large seed and crowned by calyx-lobes and style. India, near the sea. L. H. B.

474. Fruit of Barringtonia. (×⅙)

BARTÒNIA of Sims is *Mentzelia;* this is in cult. Bartonia of Muhlenberg is one of the Gentianaceæ, but is not cult.

BASÉLLA (native Malabar name). *Baselláceæ.* MALABAR NIGHTSHADE. Annual or biennial herbs, cult. in the tropics as a pot-herb, like spinach. They have bisexual, white, red or violet fls. Rarely cult. N. as an ornamental warmhouse climber. It may also be started indoors, and set out in May for use as a garden vegetable, to follow spinach. Prop. by seeds. Only 1 species, which is, however, remarkably variable.

rùbra, Linn. Lvs. succulent, alternate, rarely opposite, almost entire, of various forms: fls. not pedicelled, in simple spikes or racemes; spikes short or long, lax, few-fld. Lam. Ill., pl. 215, fig. 1. Rheede, Hort. Mal. 7, pl. 24.—The following species are now considered only forms of the above: *B. álba,* a white-fld. form rarely cult. as a trailer from roofs of warmhouses, or as a basket plant; *B. caninifòlia; B. cordifòlia,* with heart-shaped lvs. 4–5 in. long and 2–2½ in. wide; *B. crassifòlia; B. japónica; B. lùcida,* from India; *B. nìgra,* a Chinese form; *B. ramòsa* and *B. volùbilis.* Under the name of sweet malabar vine, a form with tiny yellow and red fls., and lvs. variegated with white, pink, and green has been advertised. It is said that "with age it assumes a drooping habit. When cut, keeps fresh for weeks."

BASIL. Species of *Ócimum* (sometimes, but incorrectly written *Ócymum*), of the *Labiàtæ.* They are Indian annuals, and are cult. as pot-herbs, the clove-flavored foliage being used as seasoning in soups, meats and salads. They are of easiest cult., the seed being sown in the open as soon as the weather is settled. Common basil is *Ócimum basílicum,* Linn., a foot high, branching, with ovate toothed lvs., and white, bluish white, or purplish fls. in leafy terminal racemes or spikes. *O. mínimum,* Linn., the dwarf basil, is lower, and smaller in all its parts; rarely seen and perhaps only a mere form of *O. basílicum,* Linn. When basil is in bloom, it can be cut and dried for winter use.

BASILÌMA: *Sorbaria.*

BASKET PLANTS. Under this term are included all those plants which, from their habit of growth and blooming and adaptabilities as to cultivation, have been found especially suitable for use in hanging-baskets. Figs. 475, 476.

Most of the basket plants are dwarfish subjects of indeterminate growth, of gracefully drooping or vine-like habit, and are valued either for their grace, or for freedom and daintiness of bloom. Some of the plants used in baskets are of upright habit. These are either plants of naturally small stature, or are practically such for a season from a slow habit of growth. The suitability of these erect-growing plants for the purpose is determined, aside from their stature, by their freedom of bloom, beauty of foliage, striking form, or grace of habit. Such plants are used principally for filling the central part of the basket; whereas, plants of trailing habit are inserted near the sides—some to droop, others to twine upward on the cords or handle by which the basket is suspended. In addition to the long drooping or climbing plants, there are a number of half-erect habit, like the lobelia, sweet alyssum and russelia. These may droop somewhat, but are not of a truly vine-like habit. Some plants are more suitable than others for shady places; the selaginellas, are examples. Others thrive only with several hours of direct sunshine each day.

The following list of common trade names embraces a number of the most important basket plants, arranged according to habit of growth and blooming. The list is, of course, not complete. Any list would need amending from year to year to suit individual taste and experience. Plants that withstand considerable shade are marked with an asterisk (*); those that will bear much shade are marked with two asterisks (**):

1. *Plants of vine-like habit.*

a. LONG-DROOPING.

**English Ivy, *Kenilworth Ivy, *Vinca major, *V. Harrisonii, Saxifraga sarmentosa, *Cissus discolor, *Moneywort Ivy, Tropæolums (Nasturtiums), Lonicera Halliana, L. aurea var. reticulata, Nepeta Glechoma, Ampelopsis quinquefolia, A. Veitchii. The ampelopsis is deciduous, and not suitable for winter baskets.

b. CLIMBING.

Maurandia, **Lygodium scandens, *Senecio scandens, Thunbergia, Cobæa scandens, Japanese Variegated Hop, Manettia bicolor, Lonicera Halliana, L. aurea var. reticulata, Clematis coccinea, Tropæolum peregrinum, forms of Convolvulus.

c. SHORT-DROOPING, or HALF-ERECT.

*Lobelia Erinus, *Othonna crassifolia, *Sweet Alyssum, *Tradescantia, Petunias, Oxalis floribunda, *Russelia juncea (also bears sun well), *Fittonia, *Fuchsia procumbens, Ice Plant, Verbena, *Ivy Geranium, **Selaginellas, *Begonia glaucophylla var. scandens, *Sedum Sieboldii, *S. carneum var. variegatum, *Asparagus Sprengeri, *Passifloras, *Panicum variegatum, Gazania splendens, Abutilon megapotamicum and var. variegatum, Lantana delicatissima, Solanum jasminoides, S. Seaforthianum, Convolvulus mauritanicus.

2. *Plants of upright habit.*

a. LOW-GROWING.

(1) *Flowering Plants.* —*Torenia, *Pansy, Cuphea platycentra, C. hyssopifolia, *Primula obconica, Dwarf Alyssum, Bellis perennis, Linum or Reinwardtia trigyna, Phlox Drummondii, Dutch bulbs.

(2) *Foliage Plants.* —*Peperomia, *Begonia Rex, *Farfugium grande, Alternanthera, **Maidenhair Fern, Geraniums (especially Mme. Salleroi), *Isolepis gracilis (droops with age).

b. TALLER-GROWING.

(1) *Flowering.*—Geraniums—Pelargonium, *Fuchsias, Petunias, *Begonias, Browallia, *Stevia serrata var. nana, Madagascar Periwinkle,* Nierembergia, Lantana, *Impatiens Sultana, Cuphea Llavea, Swainsona, Chrysanthemum frutescens, Salvias.

(2) *Foliage.*—*Dusty Miller, *Crotons, *Palms, **Ferns, *Fancy Caladiums, Coleus, Achyranthes, **Aspidistra, *Cyperus alternifolius, *Dracæna indivisa, *D. terminalis, Coccoloba platyclada.

475. A hanging-basket.

Some of the above plants make large subjects when growing in the open ground. Of such, only young or smaller plants are available for use in hanging-baskets. Ordinarily, several different sorts of plants are used for filling a basket. In some cases, however, a satisfactory basket is made by using but one kind of plant. A hanging-basket filled with sword fern (nephrolepis), for example, makes a handsome object.

The soil used in hanging-baskets is simply good, common, florists' potting soil. This usually contains about 25 per cent of humus, and a small amount of sharp sand to make it porous. Prior to filling, wire baskets must be lined with moss. This is merely common woodland moss from rotting logs, or rich, damp

soil. In filling baskets, a few drooping or climbing plants are disposed around the sides; then one or more upright-growing or half-erect plants, according to the size of the plants and basket, are planted in the center. Immediate effects require plants which have already made considerable growth. Florists usually carry a stock of suitable plants. In case seedlings or cuttings are grown for the purpose, it is usually best to start them in seed-pans or cutting-boxes, and transfer them later to the basket. Seeds may be sown or the cuttings started in the basket, but it is so long before they fill the basket that there is no advantage in it.

A common mistake in arranging baskets is crowding, or filling them too full. Fewer plants will appear more graceful, growth will be more vigorous, and the basket will retain its grace and beauty for a longer time. Exercise vigilance and care in watering. After the roots have well filled the basket, watering is best done by dipping the basket in a tub or barrel of water, and allowing it to remain until it is well saturated. Dipping the basket in weak liquid manure once or twice a month will greatly promote vigor when the plants have been long in the basket. These remarks also apply in a general way to vases and rustic stands.

Baskets of many patterns are obtainable from florists and other dealers. The baskets most extensively used, are made of strong wire, woven into hemispherical or other forms. These are sometimes plain, and again of ornamental character. The better form has a flat bottom, or a stand, formed of wire, to support the basket in an upright position when it is not pendent. Another style is formed of rustic work. Here the vessel or plant basin is covered about the sides with rough bark or knotted roots. For this purpose the roots of the laurel are much used. Above the basket there is an arch or handle by which it is suspended. Again, earthenware vessels, to be suspended by wires, are offered for sale in a variety of shapes. Some of these are molded and painted in imitation of logs, and are known as "stick baskets" and "log baskets." Such baskets are often without provision for drainage. When this is the case, holes should be drilled at the lowest point in the bottom. A special form of basket is much used for orchids. It is made of square cedar slats in raft- or log-fashion. Fern-fiber and broken bits of brick, flower-pots or charcoal, are used for filling them. See also the article *Vases*.

ERNEST WALKER.

476. Rustic basket (with Convolvulus).

BASSWOOD: *Tilia.*

BATÀTAS: *Ipomœa.*

BATEMÁNNIA, (James Bateman, a distinguished collector and cultivator, and author f important orchid works). *Orchidàceæ.* Epiphytic; greenhouse.

Stems thickened into pseudobulbs, 1–3-lvd.: lvs. plicate-veined: racemes arising from base of pseudobulbs; sepals and petals similar in shape; lip articulated to the foot of the column, the lateral lobes inclosing the column, the middle lobe short, entire; pollinia 2.—A single species, native of Guiana, rarely seen in cult.

Cólleyi, Lindl. Pseudobulbs 2–3 in. long: lvs. up to 10 in. long: raceme pendulous, with 4 or more distant fls. about 3 in. diam.; sepals and petals vinous, purple, the lateral sepals green-margined; lip white, red-dish stained at the base of middle lobe. B.R. 1714. B.M. 3818.

GEORGE V. NASH.

BATODÉNDRON: *Vaccinium.*

BAUÈRA (H. Gottfr. and Franz Bauer, German professor and painter, respectively). *Saxifragàceæ.* Choice little evergreen shrubs grown in greenhouses.

Leaves 3-parted and opposite, looking like a whorl of 6: fls. white to purple, axillary and solitary, but sometimes aggregated at top of the st.; calyx 4–10-divided; petals as many as the calyx-divisions; stamens few to many, borne on a disk: fr. a 2-valved caps., the valves again splitting.—Three species in Austral. and Tasmania, one of which is in cult.

These small shrubs make handsome specimen plants for the cool greenhouse, and flower most of the year, especially during the winter and spring months. Baueras are easily propagated from cuttings of half-ripened wood in spring; cut into lengths of about 2 inches, insert in equal parts of finely sifted peat and sharp sand in 3-inch pots, pricking them round the rim of the pot, and cover with a bell-glass in a greenhouse with a temperature from 55° to 60°. Give them a thorough watering at the time of insertion, and they will frequently root without further watering. When the cuttings begin to show signs of growing, they should be potted singly in 2-inch pots in the same mixture as above, and should be kept in a tight case for a few days. After they have gripped the soil, they should be cut back to about an inch above the pot, which will encourage them to branch. Baueras should never be allowed to become pot-bound until the desired size of plant is reached. The plants at all times should be kept in good shape by cutting back the strong shoots. In summer, baueras do better when plunged in a bed of coal-ashes out-of-doors, and strict attention given to watering. A cool greenhouse with a night temperature of 40° to 45° will be ideal all winter. Water occasionally with soft-coal soot mixed in water, a handful to an ordinary watering-pot; water with clean water three times and the soot-water once. (Geo. F. Stewart.)

rubioìdes, Andr. Erect or prostrate, usually 1–2 ft. in cult., but becoming 6 ft. or more: lfts. oblong or lanceolate, somewhat acute, ¼–½in. long, serrate: fls. pink or white, slender-pedicelled, the very obtuse petals exceeding the spreading or reflexed acute-toothed calyx-divisions. Inhabits swampy places. B.M. 715. L.B.C. 14:1313 (as *B. rubæfolia*).—An old favorite, blooming in spring.

L. H. B.

BAUHÍNIA (after John and Caspar Bauhin, sixteenth century herbalists, the twin leaflets suggesting two brothers). *Leguminòsæ.* MOUNTAIN EBONY. ORCHID TREE. Tropical trees and shrubs, sometimes climbing, planted in southern Florida and southern California to some extent for the flowers, odd foliage, and general attractive appearance; distinguished by the usually bifid or binate leaves; allied to Cercis.

Trees, shrubs, or vines, with showy fls. ranging from white to purple and yellow: lvs. broad, entire or 2-lobed, in some cases the lfts. being entirely free; petiole prolonged into a short but characteristic awn between the lfts.: fls. in simple or panicled terminal or axillary

racemes; petals 5, somewhat unequal, usually narrowed into a claw; stamens 10, but sometimes reduced even to 3 and perhaps bearing sterile filaments; ovary stalked, stigma in some species peltate and in others oblique: fr. a long flat pod, dehiscent or indehiscent.—About 150 species in tropics of both hemispheres. The number and fertility of the stamens are important characters in determining the subgenera. The purplish fls. of some species suggest those of some kinds of pelargonium. The bauhinias are not papilionaceous. Some of the arboreal species (as *B. variegata*) produce ebony wood. Others are gigantic climbers, sometimes mounting the highest trees.

Bauhinias are frequent in plantings in many parts of the tropics. They are planted to some extent in southern Florida and southern California. Numbers of species are likely to be introduced from time to time because of their gorgeous appearance in the tropics. In the experience of Old World gardeners, the most reliable species under glass are *B. variegata*, *B. corymbosa*, and *B. natalensis*. These can be planted outside in southern Florida in summer, and kept over winter as oleanders are. *B. variegata* and *B. purpurea* are two of the commonest and showiest small trees of India, and, although frequently introduced into northern greenhouses, have rarely succeeded permanently. *B. variegata* is much cultivated in India. The astringent bark is used in tanning and dyeing, and the leaves and flower-buds as a vegetable, the latter being pickled. Bauhinias thrive in a variety of soils on our southernmost borders. They delight in high well-drained land, but will grow on lower lands in southern Florida if it is fairly well drained or if set on slight mounds; all of them are very tender and easily affected by low temperatures, but are easily saved by banking. *B. purpurea* and *B. variegata* (*B. alba*) have withstood a temperature of 26° F. in Florida. No particular care in tillage or fertilizing is necessary, but better bloom is secured if some attention is given to these details. From seeds in Florida bauhinias grow readily and bloom freely in three or four years. Cuttings root with difficulty, but some kinds propagate readily from suckers. Bauhinias are little known as greenhouse subjects; but in the tropics they make showy and very attractive shrubs or small trees or profuse vines. (E. N. Reasoner.)

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A. *Plant climbing, or at least of climbing habit or tendencies.*

1. **yunnanénsis,** Franch. Vigorous, glabrous and glaucous throughout: lvs. coriaceous, bipartite; segms. obliquely elliptic, 3–4-nerved, rounded, 1½ in.: fls. in many-fld. pendulous racemes, rosy white striped with purple. Yunnan, China. B.M. 7814.

2. **corymbòsa,** Roxbg. Woody climber, branching from the ground: branches grooved: tendrils opposite, revolute: lvs. 1½–2 in. long, outer edges slightly rounded, inner edges straight and parallel; lfts. nearly free from each other; nerves 2–4: fls. numerous, corymbose, 1 in. across, rosy, with fluted petals, and characteristic venation; stamens bright red, 3 very long, the rest abortive. China. B.M. 6621. G.C. II. 16:204.

3. **Gálpinii,** N. E. Br. Half-climbing shrub, 5–10 ft.: lvs. 1–3 in. long, 2-lobed from one-fifth to one-half their length, 7-nerved; petiole about ¼in. long: racemes 6–10-fld.; fls. borne continuously from spring to late autumn; petals 5, all alike, 1–1½ in. long; claw as long as the limb; limb orbicular, cuspidate, brick-red; fertile stamens 3: pod 3–5 in. long; seeds dark brown. S. and Trop. Afr. B.M. 7494.—Discovered 1891.

AA. *Plant upright, a bush or tree.*

B. *Fls. white.*

4. **acuminàta,** Linn. Height 5–6 ft.: lfts. ovate, acuminate, parallel, 4-nerved, closing at night: fls. 2–3 in. across; fertile stamen long and nearly free, the other 9 short, connected, and sterile. India, Malaya, China. B.M. 7866. J.H. III. 44: 343.—One of the most satisfactory of all, either for open ground or greenhouse culture, as it will bloom the first summer, when but a few months old and but a foot or two high, and in succeeding summers blooms continuously from May to Sept.

5. **grandiflòra,** Juss. Tree, to 20 ft.: lvs. oval or subcordate, tomentose beneath, not deeply divided, the lobes ovate-obtuse and 3–4-nerved, stipules spiny: fls. very large, pure white, opening at night, 1–3 on axillary peduncles; petals obovate, acute at apex, clawed. S. Amer. R.H. 1897, p. 393.

6. **natalénsis,** Oliver. Small shrub: lvs. numerous; lfts. each 1 in. long, with a midrib and a few nerves, dark green; petioles ¼–½in. long; lfts. entirely free: fls. single or in 2's, 1½ in. across, white, the midvein of the 3 upper petals reddish; petals erect or spreading, the 2 lower ones larger; stamens 10, 5 long and 5 short: pod 3 in. long. S. Afr. B.M. 6086.—Not advertised at present.

7. **pícta,** DC. Unarmed: lvs. roundish elliptic, membranous, glabrous; lfts. semi-ovate, acutish, 5-nerved: fls. in solitary terminal racemes, white; calyx ferrugineous-tomentose; petals oblong. Colombia.

477. Bauhinia Kappleri. (×⅓)

BB. *Fls. colored (cream-color, yellow, or shades of red or purple).*

8. **forficàta,** Link (*B. furfuràcea*, Hort.). Thorny shrub: lvs. cordate at base, glabrous, cleft to middle: fls. cream-color in summer, rather bell-shaped, the petals narrow. Brazil. B.M. 3741. Gt. 10:333.

9. **tomentòsa,** Linn. St. Thomas Tree. Erect shrub or small tree, branches downy: lvs. broader than long, 1–2 in. long, coriaceous, the lobes obtuse, 7-nerved: fls. mostly in axillary pairs (sometimes 1 or 3) on pedicels bearing a pair of bractlets, yellow with red blotch on the upper petal, the petals 2 in. or less long, obovate, much exceeding calyx (which is entire): pod stalked, 4–5 in. long. India. B.M. 5560.

10. **Káppleri,** Sagot (*B. Krùgii*, Urban). Fig. 477. Strong tree, to 50 ft.: lvs. 2½ in. or less long, long-petioled, longer than broad, truncate or somewhat cordate at base, divided about one-third of the length into obtuse lobes that are about 5-nerved: fls. in short racemes opposite the lvs., whitish rose with darker and purple markings, the petals spatulate and clawed; lower stamens fertile: pod 6–10 in., narrow and curved. Probably French Guiana; cult. and partly spontaneous in W. Indies.—Attractive.

11. **purpùrea,** Linn. (*B. triándra*, Roxbg.). Small to middle-sized tree: lvs. coriaceous, glabrous, somewhat cordate, cleft one-third to one-half their depth, 9–11-nerved; lobes obtuse or somewhat acute: fls. in few-fld. axillary and terminal corymbs, fragrant; petals red, one streaked with white on the claw, oblanceolate, acute; fertile stamens 3–4, very long, the rest sterile or abortive: pod 1 ft. long. India, Burma, China.—One of the finest flowering small trees in S. Fla. Fls. are borne in the greatest profusion, 3–5 in. across, varying in color from almost white to a shade of rich purple, and marked and shaded with many tones. The plant is

robust and hardy, growing to a height of 15 ft. in less than 2 years, and blooms all winter and spring. What is known as *B. triandra* to Fla. cultivators is described as a very tender species but succeeding admirably there; growth like that of *B. purpurea* but with longer willowy branches that bear at the tips great clusters of pink fls. in late autumn or early winter, delicately scented.

12. **variegàta,** Linn. Much like *B. purpurea* in habit: tree, 6–20 ft.: lvs. 3–4 in. across, somewhat broader than long, divided one-fourth to one-third the depth, 9–11-nerved, lobes rounded; petiole 1–2 in. long: fls. about 7, in a short raceme or corymb, 4 in. across; calyx spathe-like; petals 5, clawed, obovate-oblong, veined, rose-colored and variegated with red and yellow, the lowest one larger, broader above the middle, strongly marked with crimson: pod 1–2 ft. long. India. B.M. 6818.—The coloring of the fls. varies. Var. **cándida,** Roxbg. (*B. álba*, Buch-Ham.). Height 12 ft.: fls. white, beautifully veined with green: fls. Feb.–May. B.M. 7312.

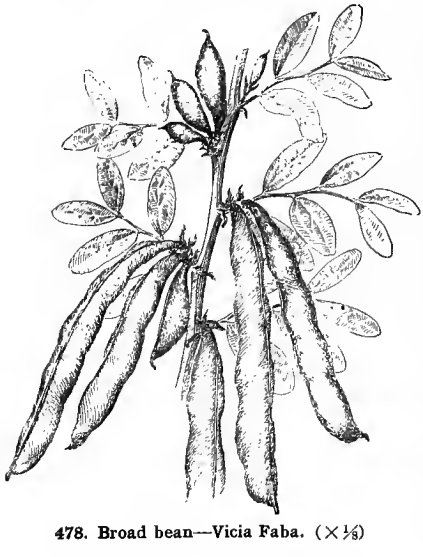
Numbers of bauhinias may be expected to appear in plantings along the southern borders. The following names have already occurred: *B. cándicans*, Benth. Closely related to B. forficata. Spiny: branchlets and racemes whitish tomentose: lvs. pubescent below, 9-nerved: petals nearly 3 in. long. Uruguay, Argentina.—*B. Hoòkeri*, F. Muell. Large tree: lfts. distinct, broad, very obtuse, 5–7-nerved: fls. white, edged with crimson, in few-fld. terminal racemes; petals clawed, the blade about 1½ in. long. Austral.—*B. Richardsonii*, said to be from Mauritius; unidentified.

L. H. B.†

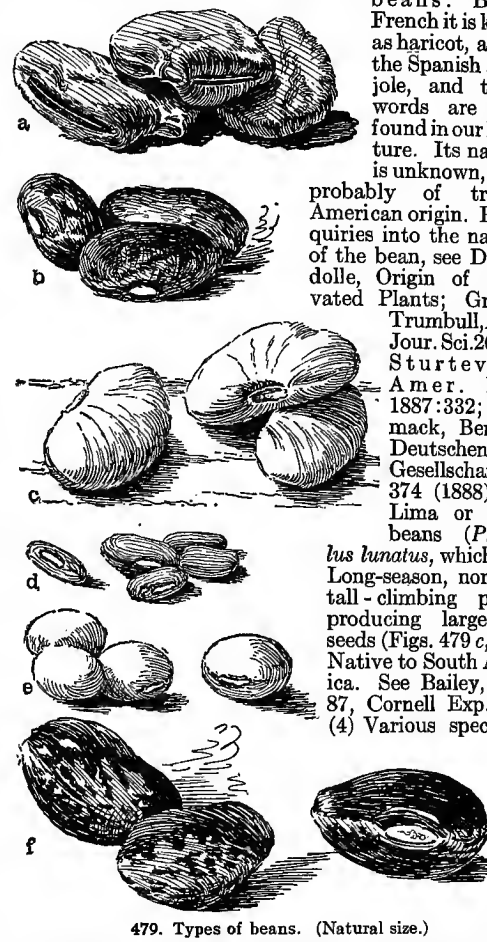
BAY TREE: *Laurus.*

BEAN. A name applied to various plants of the *Leguminòsæ*. The word is commonly used for herbaceous plants of the Phaseolus tribe, but it is sometimes employed for seeds of leguminous trees and shrubs. The species of true beans (Phaseolus and closely allied genera) are yet imperfectly understood. The bean differs from the pea, among other things, in being epigeal in germination (cotyledons appearing above ground). Some of the plants to which the name is applied are really peas.

The beans chiefly known to horticulture are of five types: (1) The Broad bean (*Vicia Faba*), or the bean of history, an erect-growing plant, producing very large and usually flat, orbicular or angular seeds. Probably native to southwest Asia (Figs. 478, 479 *a*). See *Vicia*. These types of beans are extensively grown in Europe, mostly for feeding animals. They are either grown to full maturity and a meal made from the bean, or the plant is cut when nearly full grown and used as forage or made into silage. The Broad bean needs a cool climate and long season. In the United States, the summers are too hot and dry for its successful cultivation on a large scale, and the plant is practically unknown here. In Canada, the plant has been used with corn to make silage; and this combination has been called the "Robertson mixture." (2) Kidney bean (*Phaseolus vulgaris*; Figs. 479*b*, 480). This is the plant which is everywhere known as bean in North America, comprising all the common field, garden, snap and string beans. By the French it is known as haricot, and by the Spanish as frijole, and these words are often found in our literature. Its nativity is unknown, but is probably of tropical American origin. For inquiries into the nativity of the bean, see DeCandolle, Origin of Cultivated Plants; Gray & Trumbull, Amer. Jour. Sci. 26:130; Sturtevant, Amer. Nat. 1887:332; Wittmack, Ber. der Deutschen Bot. Gesellschaft, 6: 374 (1888). (3) Lima or Sugar beans (*Phaseolus lunatus*, which see). Long-season, normally tall-climbing plants, producing large, flat seeds (Figs. 479 *c*, 481). Native to South America. See Bailey, Bull. 87, Cornell Exp. Sta. (4) Various species of Dolichos (as *D. sesquipedalis* of gardens), or closely related things. Vines which produce very long, slender pods and small, narrow beans (Figs. 479 *d*, 482). Native to tropical America. (5) Soy, or Soja, bean (*Glycine hispida*). A bushy, erect, hairy plant producing small pods in clusters, and pea-like seeds (Figs. 479 *e*, 483). In this country used mostly for forage. Native to China and Japan, where it is much grown.



478. Broad bean—Vicia Faba. (×⅛)



479. Types of beans. (Natural size.)

a. Vicia Faba. *b.* Phaseolus vulgaris. *c.* Phaseolus lunatus. *d.* Dolichos sesquipedalis (properly a Vigna). *e.* Glycine hispida. *f.* Phaseolus multiflorus.

Aside from these types, there are others of less economic importance. The Scarlet Runner type is a perennial phaseolus (*P. multiflorus*), grown in this country mostly for ornament (Figs. 479*f*, 484). The Tepary bean, now gaining prominence in the Southwest, is a form of *Phaseolus acutifolius*, a native species. Various other species of Phaseolus are also cultivated in various parts of the world under the name of beans. *P. radiatus* is prized in Japan, and has been introduced into the United States as Adzuki Bean (see Georgeson, Bull. 32. Kan. Exp. Sta.). *Vigna sinensis*, known in North America as cowpea (which see), is sometimes called a bean. The Velvet bean of the South is a Mucuna (which see), recently, however, referred to Stizolobium. The Jack bean is a Canavalia (Fig. 485). Recent American studies on varieties and types of beans are Irish, Rep. Mo. Bot. Gard. 1901, 81–165;

Jarvis, American Varieties of Beans, Cornell Bull. 260 (1908); Freeman, Ariz. Bull. 68 (1912).

The sea beans of the Florida coast are seeds of various tropical leguminous plants, and are transported by ocean currents (see Coe, in G.F. 7:503).

For botanical treatment, see *Dolichos, Glycine, Phaseolus, Vicia, Vigna.* L. H. B.

Culture of the bean.

For the purposes of the practical gardener, the various types and numerous varieties of the bean may be classified in two groups, in two different ways, namely, either as "field beans" and "garden beans," or as "bush beans" and "pole beans." Field beans are grown on a large commercial scale for the dry-shelled seeds, either as a farm crop in regular rotation, as corn and potatoes are grown, or at times as a subsidiary or chance crop, or side line, in young orchards, and so on, but are not usually found in the home- or market-garden, where highly manured soil would tend to stimulate growth of foliage at the expense of seed-production. Field beans belong mostly or entirely in the class of bush beans. The garden beans are more commonly grown for their succulent pods and immature seeds, and include both bush and pole or "running" sorts. The latter come almost exclusively under the head of "garden" beans.

480. Common or Kidney bean.—Phaseolus vulgaris.

The great economic value of the bean is generally recognized, not alone in respect to its high place as a farm and garden crop, but also as the most suitable material, next to animal products, in compounding a balanced ration for man, and to some extent for beast, and as a substitute for dear meats.

Beans are easily forced under glass, in a temperature suitable for tomatoes. They may be grown either in pots or beds. The bush varieties, as Sion House, are preferred. Keep them growing, and look out for red spider.

Field beans.

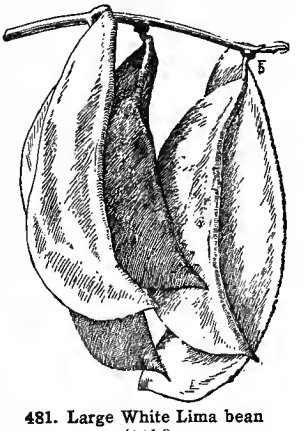
Ordinary field beans like a fairly good warm farm soil, such as will suit corn or potatoes. They do not draw very heavily on the fertility of the land. Belonging to the legumes, they are able to make use to a large extent of atmospheric nitrogen, and if given a good start will not only look out for their own needs in that respect, but may leave the land better supplied with nitrogen than it was found at planting-time. They will not thrive on wet or badly drained land; otherwise good strong loams, or soils resting on limestone, are considered most desirable, with sandy loams and gravelly loams next in order. They should have a fair but not excessive amount of humus. A few loads of fine old stable manure spread evenly on the surface after plowing, if possible supplemented with fifty or a hundred pounds of muriate of potash and a few hundred pounds of dissolved rock (acid phosphate) or other phosphatic manure, may be expected to give good returns. Or, in the absence of these chemicals, 200 pounds or so of a commercial fertilizer such as is usually applied for grain crops, and which analyzes about 2 or 3 per cent of nitrogen, 8 of phosphoric acid and 3 or 4 of potash, may be applied broadcast after plowing. Although the planting should not be done until after the soil has become warm, in the northern states not before June, the customary planting-time in the great bean-producing sections extends from June 1 to June 25; it is, nevertheless, of great importance to plow the land early and keep it worked with disk or other harrows until planting-time; this for the purpose of preserving moisture and getting ahead of the weeds. Important also is the use of good hand-picked seed beans, not over one year old, and free from weevils and disease infection. The rows are to be made 28 to 36 inches apart, and for small areas, planting by hand or with a corn-planter will do. For planting on a larger scale, a regular bean-planter or a grain-drill with part of the tubes stopped up so as to bring the rows the correct distance apart should be used. If fertilizer is to be applied with the drill at the same time, it may be allowed to run from the hoe or tube on each side of each tube that discharges the seed beans.

Among the varieties generally grown in field culture are the Pea or Navy, the Medium, Red and White Kidney. The Pea bean is small but early and prolific, and considered to be about as profitable as any other under ordinary circumstances. It is particularly recommended for the small or home grower.

The harvesting comes when the pods have ripened and the leaves have dropped off, and is to be done with a bean-puller or harvester, taking two rows at a time, or in a small way by hand-pulling. The vines are put in small heaps, allowed to cure, and promptly stored out of the way of moisture, afterwards threshed with a bean thresher, or in a small way with the flail, cleaned, sorted by hand (in a large commercial way with the help of a bean-sorting device), and marketed.

Garden beans.

The warm and fertile soil of the average home- or market-garden suits the requirements of the "garden" beans, as they are mostly grown for their tender and succulent pods and not for their seeds, or, as in the case of the lima and several others, for their seeds in an immature or half-developed state. The pods of all these garden beans should be picked promptly and clean in order to prolong the bearing period as much as possible. If the beans are allowed to ripen on the vines, the latter will soon give out. Only when these garden beans are grown for seed purposes is early and even ripening desirable, and in that case the pods, perhaps with the exception of the first setting if light, must all be left on. A good string bean has a thick, meaty pod which snaps off clean when broken, leaving no string along the back.



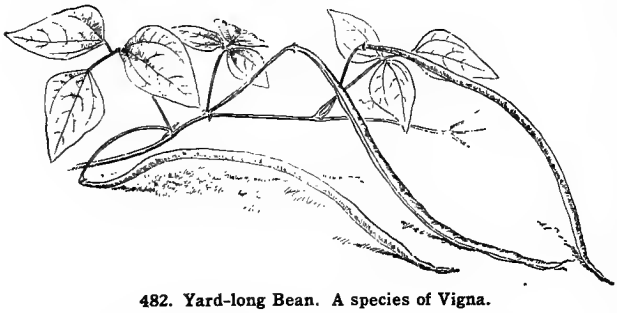
481. Large White Lima bean (×⅓)

Many varieties which answer this description are offered in the various seedsmen's lists, both green-podded and yellow-podded. Early Valentine, with its many strains (Red, Black, Earliest Improved, and so on), is still in favor with growers for a green-podded variety. A newer good one is Stringless Green-Pod. Quite numerous are the yellow-podded sorts. Among them are Black Wax,

Golden Wax, Davis Kidney Wax, Wardwell Wax, Hodson, and others.

Pole beans.

Pole or running varieties of beans require especially fertile soil; and for that king of table beans, the lima of all forms, too much can hardly be done in the way of enriching the ground. Warm soil is one of the first essentials of success in growing pole beans. When poles are to be used for support, they should be set not less than 4 feet apart each way, before the beans are planted. Four or five beans are to be placed around each pole, 1 to 1½ inches deep. While it is a safe rule to put the seed eye downward, it is not a necessary condition of prompt and uniform germination. In case of absence or scarcity of poles, a serviceable, cheap and ornamental trellis may be constructed by setting posts firmly at proper distances along the row, connecting them with two wires, one a few inches and the other 5 or 6 feet from the ground, and finally winding cheap twine zigzag fashion around the two wires. Cultivate and hoe frequently. A top-dressing of good fertilizer, or of old poultry- or sheep-manure, hoed in aroud the plants, may be of great help in keeping up the productiveness of the plants to the end of the season. To have a continuous supply during the entire season, the pods, when large enough, must be gathered frequently and clean. Among the varieties used both for string and shell beans, are the Green-podded Creaseback,



482. Yard-long Bean. A species of Vigna.

several wax varieties, Golden Cluster, and the popular Horticultural or Speckled Cranberry bean, besides any number of others. A very fine bean is the Dutch Runner (Fig. 484), which approaches the lima in quality and resembles it in habit of growth. The seed is of the largest size and clear white in color. Highly ornamental is the closely related Scarlet Runner, with its abundance of showy scarlet blossoms. This latter bean is grown in Europe for eating, but is rarely used for that purpose here.

Lima beans.

Of all pole beans, the limas have undoubtedly the greatest economic value. They enjoy a deserved popularity, and are usually grown with profit by the market-gardener. The varieties might be classed in three types, —that of the Large Lima, the Dreer Lima, and the Small Lima or Sieva. Each of them has a number of sub-varieties or strains, and appears in both pole and bush form. The old Large Lima (Fig. 481) is a very large, flat bean, and yet largely grown for main crop. To the same type belong Extra-Early Jersey, King-of-the-Garden, and others. The pods of these are very large, and the beans in them somewhat flattened.

There are dwarf forms of both sieva and the regular lima. The Burpee Bush Lima is a form of the large lima type. The Dreer Lima of both forms is appreciated especially for its high quality. The seeds are more roundish and crowded close together in the pods, the latter being much smaller than those of the Large Lima. The seeds of these two types are light-colored, with a greenish tinge, but the Large Lima is also represented by red and speckled (red-and-white) sports. The Small Lima or Sieva, with its dwarf form, Henderson Bush Lima, seems to be hardier and earlier than the two larger types, but pod and bean are quite small. The color of this bean is nearly clear white, but there is also a speckled sub-variety of it. Wherever there is a place for the Sieva, its bush form will be appreciated. The bush forms of the two larger types, however, are not uniformly productive enough to take the place of the pole forms entirely. The latter will often be preferable when a season of continuous bearing is desired.

Lima beans require a long season, and therefore are not much grown along the northern borders and in Canada. They must be given warm and "quick" soil and kept constantly growing.

Other beans.

Three other members of the bean tribe might be mentioned in this connection; namely, the Black bean or cowpea of the South, the Japanese Soy bean, and the English or Broad bean. The cowpea takes, in some measure, the same place in the southern states that red clover takes at the North, being used both as stock food and as a green-manure crop. There are many varieties of it, early and late, some of strictly bush habit and some producing long runners. See *Cowpea.* Of greater value for the same purposes, north of New Jersey, seems to be the Japanese Soy bean, which is early enough to come to maturity almost anywhere in the United States. Its foliage is rather thin or open, however, which impairs its value for green-manuring. The dry bean constitutes one of the richest vegetable foods known, and its flavor seems unobjectionable to all kinds of stock. Sow one bushel to the acre. Similar to this in value is the English Broad bean, several varieties of which, as the Broad Windsor, the Horse bean, and others, are grown and are popular in England and in some parts of the European continent. In most parts of the United States they are scarcely known, and in none generally cultivated. Only a few of our seedsmen list them in their otherwise complete catalogues. Yet they are a decidedly interesting group of plants, and worthy of greater attention in the cooler parts of the country. Being about as hardy as peas, they may be planted much earlier than would be safe for ordinary beans. The Windsor is used in England in much the same way as lima beans are used in America; but the latter are so much better that in the United States there is no need of planting the former as a table vegetable. The varieties with smallish seeds are sometimes grown and used in parts of Europe for feeding pigeons and chickens; and under certain conditions might have some value here for the same purpose on account of the high protein content.

Insects and diseases.

The foliage of the various beans is rarely attacked by insects. A somewhat serious pest, however, which attacks the seeds both in the pod and dry, after being shelled, is the bean-weevil, a smaller brother of the pea-weevil, and having nearly the same general habits of development. If only beans free from live weevils are used for seed in a given locality, the product will be free from them also. For that reason, all beans to be used for seed, or for food, if suspected of being weevil-infested, should be subjected to the carbon-bisulfid treatment in the fall. It is simple, but care should be taken to keep the highly inflammable drug away from an open fire or light. Place the beans in a tight receptacle. Pour a quantity (half pint to barrel) of the bisulfid into a saucer or other flat dish, which place on top of the beans, and cover the receptacle tightly, leaving it thus for twenty-four hours or more.

Difficult to control is the bean blight, a disease which frequently affects field, garden and lima beans. Seed

from an affected field should not be used, nor should beans be planted again on a field for several years after having been affected. For bean anthracnose, also called bean rust (erroneously) and pod-spot, which is easily recognized by the dark or brownish spots on the pods and occurs both on field and garden beans, there is one sure preventive. Plant clean seed and grow a practically clean crop. It is advisable for the grower to select his own seed beans, carefully rejecting every pod that shows the least sign of the disease. The true bean rust is not so often met with, therefore not so serious.

T. GREINER.

Lima beans in California.

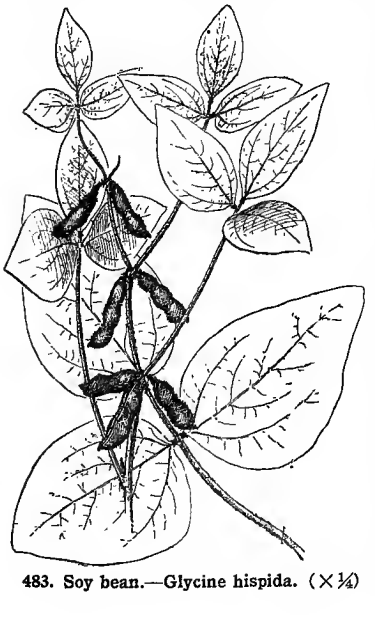
Lima beans are grown in California very extensively as a field crop, supplying the markets of the country with the bulk of the dry shelled product. The figures for the lima bean crop of 1910 in California are as follows:

	Sacks
Ventura County	800,000
Orange County	150,000
Santa Barbara County	75,000
Los Angeles County	75,000
San Diego County	60,000
Total	1,160,000

The above represents a total of about 82,850 acres devoted to this crop.

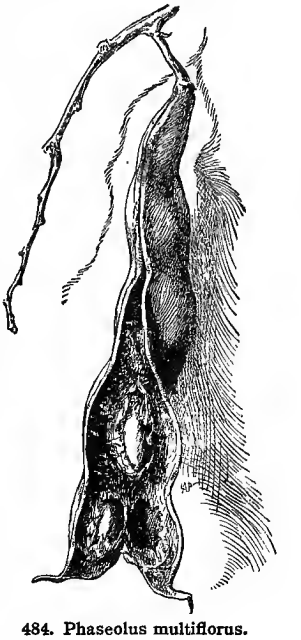
Lima beans delight in warm, summer weather, but if the relative humidity is low, they suffer in consequence. Along the California coast, which is the heaviest producing section, the fogs are remarkably constant in the night and early morning, and when for a week or ten days these fogs are lacking, the bean crop suffers markedly. The small pods that are just forming dry up and fall off without making seed. The heavy fogs which roll in may add a little moisture to the surface soil for a time, but not enough to reach the roots and aid the plants directly. The great benefit of the fog is in lessening evaporation and tempering the atmosphere, less water passing from the plant into moist atmosphere than would pass into dry atmosphere.

The profitable production of lima beans is limited to some extent by soil, though not so much as by climate. They are grown on soil ranging all the way from sandy to adobe. The lima bean plant does not grow well on an acid soil; neither does it thrive on an alkali soil. California soils, being mostly arid or semi-arid, are not badly leached, and therefore lime is usually abundant, insuring freedom from acidity. But the same aridity and consequent lack of leaching is responsible for the accumulation in some lands of considerable amounts of alkali salts, enough to limit the area and the production in the counties where the bulk of the limas is grown. The amount of alkali which this bean can endure and still produce paying crops has not been definitely determined, but it is not high. However, experience has shown that the lima will bear more alkali than the Blackeye, Lady Washington, or other beans of the common kidney type.



483. Soy bean.—Glycine hispida. (×¼)

The difference in time of maturity is very great between sandy and clayey soils, and still greater between dry and moist soils. A difference of a week may be observed in the same field, due to physical variations in the soil, and much more than this difference in time has been frequently observed within the distance of a few miles. It seems that the water-supply of the soil more than the texture is responsible for this difference in time of ripening, as irrigation on light soils causes the same lateness in maturity. Thus, a tendency is found toward the perennial habit which the plant maintains under the humid conditions of the tropics.



484. Phaseolus multiflorus. (×½)

Soils with much nitrogen tend to produce late maturity; hence the limas ripen later on land which has been recently manured. On the other hand, the mineral elements tend toward early maturity. Limas require a richer soil than do the white kidney beans; the pole varieties require a richer soil than the bush varieties.

The standard preparation of land for a bean crop is practised. Growers have learned by experience that good preparation pays; in fact, very much more cultivation is given the soil before seeding than after.

Planting is from May 1 to May 25, at the rate of forty-five to sixty-five pounds per acre, according to the moisture condition and fertility of the soil. The beans are planted in rows 30 to 36 inches apart, 8 to 12 inches apart in the row, a single seed being dropped in a place. On the heavier and more moist soils, where the growth of vines is rank, the wider distances are given between rows. Two inches in the moist soil is considered the best depth of planting.

The beans are tilled while young, one, two or three times, the average number of cultivations being two or a little more. The fields are ordinarily kept free from weeds from the time of working in the winter till the vines cover the ground. Cultivation must cease when the vines get large, as, not being provided with supports, they spread across the row and would be badly injured by the passage of the cultivator. After the vines have made such a growth as practically to cover the ground, the mulch is not so much needed to prevent evaporation.

Irrigation in California.

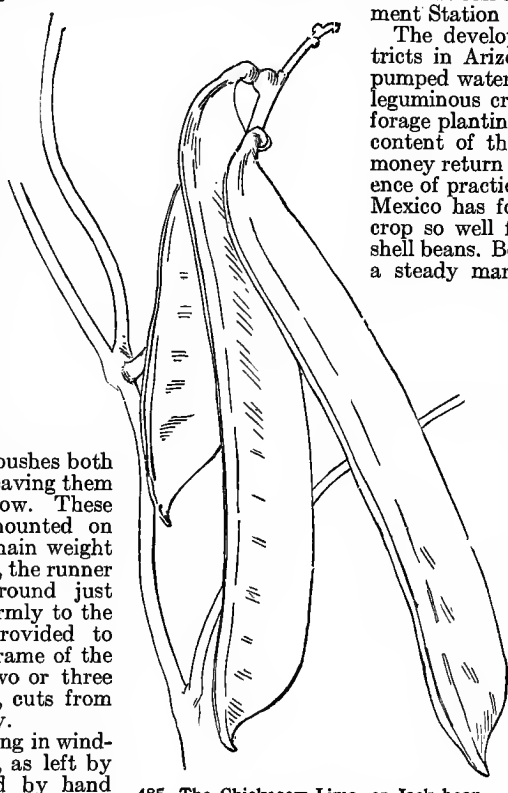
As there is normally no rain on the bean crop in California from planting till harvest, the ground, of course, becomes very dry. Hence irrigation has been found profitable, the production in many fields being doubled by the use of water. The most common method of irrigation is by the row system. Furrows are made between all the rows with an implement carrying four broad shovels, furrowing between four rows at a time. Water is run in these furrows for the desired time, after which the land is leveled by a shallow cultivation. This prevents excessive evaporation which would take place if the furrows were allowed to bake in the sun. Usually only one irrigation is given, and that about July 1st, just before cultivation ceases. Two and

one half to 3 acre-inches per acre are applied at this time.

Harvesting, and caring for the product.

In the sections of light and unirrigated land, the beans ripen from August 20 to September 10. In the irrigated parts and on heavier land, they ripen from September 10 to September 25 or October 1. These dates indicate the time the beans are harvested. Before the earliest date for each section there will be some dry pods in all the fields and at the latest date of harvest there are always green pods.

The beans are harvested by a seed-cutter with two runners 12 to 15 inches high. On the inner side of each a knife is set diagonally backward and toward the middle of the sled. A few inches above each knife is a bar of iron or wood set in a similar position. The sled-runners are such a distance apart that two rows of beans will pass between them. Hence each knife is drawn along the line of the row cutting the plants just below the surface of the ground. The diagonal position of the knife causes it to cut the plants clean without pulling up by the roots, and together with the diagonal bar above, pushes both rows to the middle, leaving them together in a windrow. These cutters are often mounted on wheels to bear the main weight of the sled and driver, the runner cutting into the ground just enough to hold it firmly to the row. Levers are provided to raise and lower the frame of the sled. A man with two or three horses, usually three, cuts from 8 to 12½ acres a day.



485. The Chickasaw Lima, or Jack bean.—Canavalia ensiformis. (×⅛)

The vines, after lying in windrows for a few hours, as left by the cutter, are piled by hand with pitchforks. Three windrows are commonly placed together in one row of piles. Piles are 4 or 5 feet in diameter on the ground and 3 feet high. They remain in these piles till very dry, which is a length of time varying with the weather and the maturity of the beans, but usually from two to three weeks. A man is expected to pile about 5 acres a day, but frequently does not pile more than 2 or 3 acres. It requires from two to three men to handle the beans cut with one sled.

Threshing is done by itinerant machines, using for power either steam or gasolene engines. The machines thresh from 1,000 to 2,500 sacks per day, 1,500 being a fair day's work. In a few instances about 3,000 sacks have been threshed in a day. The charge is usually 25 cents a hundred pounds, equal to 20 cents a sack. The beans are stored in large warehouses until marketed, and are generally recleaned by a mechanical recleaner which is very satisfactory.

Yield and value of crop.

The average yield is about fourteen sacks, eighty pounds per sack, or about 1,120 pounds per acre. Some fields produce nearly three times this amount, but in the best section an average of twenty-five sacks or 2,000 pounds per acre is considered to be satisfactory.

Another factor which is of importance, and which has only recently come to be appreciated, is the value of the bean straw as rough feed. It is generally regarded that the straw is worth about $1 per ton in the field, loose.

GEORGE W. SHAW.

Tepary beans.

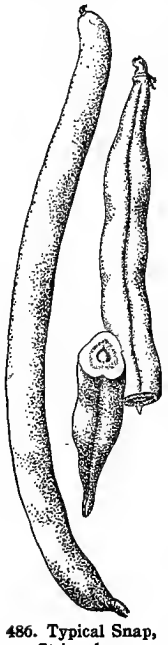
The tepary is a small white bean native to the southwestern region of the United States (*Phaseolus acutifolius* var. *latifolius*), long grown by the Indians and now receiving attention from general cultivators. The first full acount is in Bulletin 68, Arizona Experiment Station (1912).

The development of artesian and dry-farming districts in Arizona, together with the increased use of pumped water for irrigation, have created a need for a leguminous crop which, used in rotation with grain or forage planting, will maintain the nitrogen and humous content of the soil and at the same time provide a money return which is sure and profitable. The experience of practical farmers throughout Arizona and New Mexico has for years demonstrated the fact that no crop so well fills this demand as the growing of dry shell beans. Being a countrywide food staple, they have a steady market which is little influenced by local conditions other than transportation charges. As corn in Illinois, cotton in Texas or wheat in Kansas represent to their producers products of staple value, so may the dry-farmers of the Southwest, and those irrigating with artesian and pumped waters, look to the bean as a money-crop which at all times may be surely and readily turned into cash.

Varieties of beans originated in the humid sections of the East are of but little value when grown in Arizona. They do not withstand satisfactorily the extreme aridity and heat of the air during the summer months. Out of a large number of varieties tested at Yuma, only those of southwestern origin were at all successful.

Among these southwestern varieties of beans, first tested at Yuma in 1909, certain ones were noted which gave yields far in excess of all others, including even the much-prized pink bean, or frijole. Subsequent investigations developed the fact that this group of varieties (known as teparies) was distinct from either the common kidney or snap bean. They were found to constitute a new species, hitherto unrecognized as a cultivated plant in botanical or horticultural literature. It has been described by the writer as a new variety of *Phaseolus acutifolius*. In its wild state, *Phaseolus acutifolius* is peculiar to the southwestern desert region. It may be found on the mountain-sides and in narrow valleys from the Pecos river westward across New Mexico and Arizona and southward into the adjoining states of Mexico. Domesticated from the neighboring cañons and cultivated in small patches, attended at best by a crude husbandry and dependent upon the precarious summer rains and uncertain floods from the mountain washes for irrigation, the tepary has lost none of its native hardiness. It has been cultivated by the Papago and Pima Indians from prehistoric times and in all probability formed one of the principal food-crops of that ancient and unknown agricultural race, the ruins of whose cities and irrigating canals are now the only witnesses of their former presence and prosperity.

While growing, the tepary may easily be distinguished from the common garden bean by its more slender vines and smaller leaves. The leaves are also thinner, smoother, narrower and more pointed at the apex than those of the bean. The pods are smaller than those of the bean, averaging about 3 inches long and $\frac{2}{5}$ inch wide. Being somewhat flattened and having thin, rather tough walls, the pods might resemble rather closely a small variety of the lima. Teparies, however, differ markedly from either the bean or the lima in the length of the stems bearing the first pair of aërial leaves. For teparies these measure only about $\frac{1}{6}$ inch, whereas for beans and limas they will average an inch or more. The seeds of the tepary are smaller than those of the other sorts mentioned and there are a number of minor differences which suffice to give them a distinctive appearance at least to those who are familiar with the group. The seeds of the white variety are very similar to those of the navy bean, with which they would in all probability be classed on the general market. A convenient test for shelled tepary beans is to immerse them in water. They will wrinkle in five to ten minutes; while other cultivated species commonly require forty-five minutes to one hour.



486. Typical Snap, or String beans. (×½)

The tepary as a food.

There is considerable difference of opinion as to the relative palatability of beans and teparies. Among the Indians and Mexicans, the commercial pink bean is preferred to the tepary, as they say it has a better flavor. These people, however, make the same difference between the pink bean and the white navy which is shipped in from the East. Teparies should be soaked twelve hours before cooking, during which time they swell to at least twice their original volume and more than double in weight. In this respect they markedly surpass other beans. Well-cooked teparies are light and mealy and have a rich bean-like aroma. Boiled and baked with bacon or mashed and added to soups, they form most acceptable dishes. To such as are fond of the onion, a small amount of this vegetable finely chopped and stirred in during boiling makes a pleasing addition.

Yields and culture.

The superiority of the tepary over other beans for planting in the Southwest is exhibited in its greater productivity when grown under similar conditions. This statement is not only true in irrigated sections, but even more marked in regions devoted to dry-farming. In nine experiments in Arizona covering almost every condition of soil, culture and water-supply, and extending over three years, the average yield of the teparies has been slightly more than four times the average for varieties of the kidney bean. These greater yields are due to the ability of the tepary to germinate quickly in the presence of a low moisture-content of the soil, with the resulting better stands on dry lands. The tepary is also able to withstand protracted seasons of drought without permanent injury, returning to full vigor immediately when the rains come. Other beans do not possess this ability to a marked degree. The tepary is also inured to the greatest extremes of summer temperatures and will bloom and set seed any month from May to November. On the other hand, when the blooming period of common beans happens to fall within a season of extreme heat, the buds will for the most part drop without setting pods. For these reasons the tepary is a more sure and dependable crop, often giving fair returns when beans are a total failure. With an ample supply of water, good soil and other conditions favorable, teparies should yield 700 to 1,200 pounds per acre. However, 1,500 pounds per acre have been reported from the Colorado Valley near Yuma. Under dry-farm conditions, yields of 450 to 700 pounds have been reported. On irrigated lands, teparies may be planted in southern Arizona any time from the early spring when danger of frost is past until August 10. The best crops however, are secured by early planting, March 20 to April 1, or by midsummer planting, July 12 to 25. In dry-farming, they are planted any time from the 10th to the 15th or 20th of July.

487. Bedding.—Arundinaria Veitchii.

GEO. F. FREEMAN.

BEARBERRY: *Arctostaphylos.*

BEAR'S BREECH: *Acanthus.*

BEAUCÁRNEA: *Nolina.*

BEAUFÒRTIA (Duchess of Beaufort, patron of botany). *Myrtàceæ.* Greenhouse red-flowered shrubs, blooming in spring.

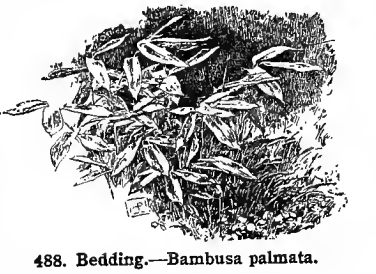
Stiff, more or less heath-like shrubs: lvs. commonly opposite, small and rigid, often only 1-nerved: fls. in heads or short spikes, sessile; calyx 5-lobed; petals 5, spreading; stamens many, longer than the petals, in bundles opposite each of the petals; ovary 3-celled: fr. a loculicidal caps. borne in the hardened calyx-tube.—Twelve or 13 species in W. Austral. Requires the treatment of coolhouse Australian things, with peaty soil. Prop. by maturing shoots under glass.

purpûrea, Lindl. Small free-flowering shrub, with virgate branches: lvs. ovate-lanceolate or narrower, becoming linear on the small branches: fls. small, purplish red, the petals shorter than the erect subulate calyx-lobes.

L. H. B.

BEAUMÓNTIA (after Mrs. Beaumont, of Bretton Hall, Yorkshire, England). *Apocynàceæ.* Hothouse white-flowered twiner.

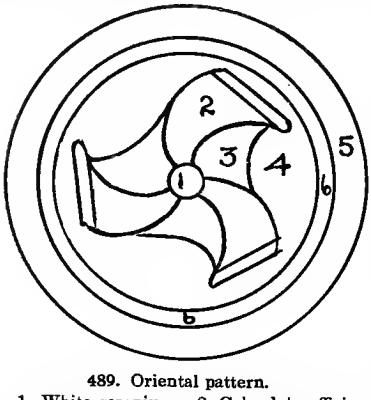
Corolla funnelform, short-tubed, without scales in the throat, with 5 broad lobes; stamens 5, included, attached to corolla; disk 5-lobed or of 5 scales. The genus is more nearly allied to the familiar greenhouse shrub *Trachelospermum jasminoides* than to the splendid tropical climbers in Allamanda and Dipladenia.—Four or 5 Indian or Javanese trees or tall climbers, with very large, white, fragrant, bell-shaped fls. in terminal cymes.



488. Bedding.—Bambusa palmata.

B. grandiflora has been neglected of late, presumably because it needs so much room. It should be planted out in strong, fibrous, loamy soil of a warm-house, as it rarely succeeds in pots. It is best trained to the roof, as full light is necessary for flowering, if not for growth. The shoots may be thinned if the large leaves cast too much shade on the plants beneath. The wood should be well ripened to produce an abundance of winter bloom. The flowers are produced on the

growth of the previous season. After flowering, the plant should be severely pruned to produce lateral shoots for the next season's bloom. In its native country, this vine climbs over very tall trees.



489. Oriental pattern.

1. White geranium. 2. Calendula officinalis, "Orange King." 3. Coleus, green. 4. Verbena hybrida Purple Mammoth, or Lemoine's heliotrope. 5. Alyasum variegatum. 6. Outline of black-red coleus bounding all parts.

grandiflòra, Wall. A tall-growing, woody vine: lvs. obovate, cuspidate, wavy margined: sepals 5, large, ovate, wavy, pink-tipped; corolla-tube veined with green, the limb 5-cleft. B. M. 3213. Gn. 45, p. 138; 49, p. 314. J.H. III. 28 : 243. Var. supérba, having larger whiter fls. than the type, is known.

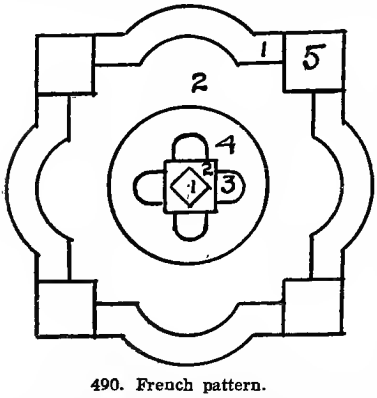
B. frágrans, Pierre. Evergreen shrub with white, fragrant, shallow bell-shaped fls. Cochin China. G.C. III. 49:306.—*B. Jerdoniàna*, Wight. Similar to the above but with smaller parts, and with follicles 10 in. long. Cult. only in rare collections. Wight Ic., pl. 1314.

N. TAYLOR.†

BEDDING, or BEDDING-OUT. The temporary use out-of-doors of plants that are massed for showy and striking effects. There are four main types: spring, summer, subtropical and carpet-bedding.

Spring bedding.

The most temporary of all forms of bedding is that designed only for spring effects. It is usually followed by summer bedding in the same area. It is the only kind that largely employs hardy plants, as crocuses, narcissi, daffodils, tulips, hyacinths, and other Dutch bulbs. All four types of bedding are commonly seen in public parks, but spring bedding is the most appropriate for amateur and home use, as the bulbs flower at a dreary time of the year, when their brave colors are most cheering, and also because they are much more familiar than the subtropical and foliage plants of summer. Moreover, hardy bulbs are more easily cultivated than any other class of plants, and they are cheap. The main principle is to plant them early enough to secure a strong root development. Therefore, they should be ordered early, and planted in the latter part of October or first of November. The colors may be massed or mixed according to taste, the terms massed and mixed bedding referring to unity or variety of effect, and being applicable in each of the four main types mentioned above.



490. French pattern.

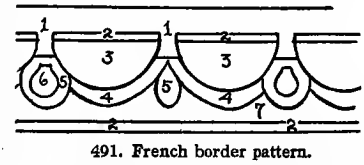
1. Calendula officinalis, "Sulphur Queen." 2. Ageratum nanum, "Blue Perfection." 3. White geranium. 4. Scarlet geranium. 5. Pink geranium. Palm at center for accent. Whole design outlined with green alternanthera.

Opposed to this style of bedding is the naturalizing of bulbs in the lawn. Crocuses and squills are particularly charming when they appear singly, or in twos or threes, at unexpected places in the lawn. Daffodils are frequently naturalized in large masses in spots where the grass is not mowed.

Pansies are the only other plants that are used extensively for spring bedding. English double daisies and catchflies are largely used for edgings. Pansies are set out between April 1 and 15. In large operations, pansy seed is sown in August of the preceding year, and the young plants are transplanted once and wintered in a coldframe. After flowering, the plants are thrown away. The other method is to sow the seed in a greenhouse in January. The August-sown pansies give larger and earlier blooms, but the January-sown pansies will last longer, and in partially shaded places will give scattering bloom all summer, especially if protected from drought.

Summer bedding.

Bedding for summer effects often follows spring bedding in the same space of ground, and employs chiefly geraniums, coleus, begonias, ageratum, salvia, vinca, alyssum, petunia, verbena, heliotrope, grasses, cacti, and aquatic plants, the culture and varieties of which may be sought elsewhere in this work. As to tenderness, these fall into two groups, the first of which may be set out about May 15 in New York, and the second about June 1. Geraniums are the most important of the first group, and coleus is an example of the tenderest material, which is set out simultaneously with subtropical plants when all danger of frost is past.



491. French border pattern.

1. Marguerite, "Queen Alexandra." 2. Coleus, "Golden Bedder." 3. Scarlet geranium. 4. Cineraria maritima. 5. Calendula officinalis, "Sulphur Queen." 6. Ageratum nanum, "Blue Perfection." 7. White geranium.

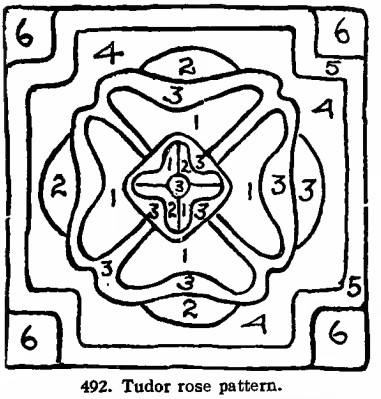
As to fondness for sunlight, there are again two groups, but the only bedding plants of importance that prefer shade are tuberous begonias and fuchsias. The popularity lately achieved by tuberous begonias in Europe will probably never be duplicated in America. The secret of their culture is shade, shelter, and moisture at the roots. Therefore, a clay bottom is desirable for a bed of tuberous begonias, as being more retentive of moisture than a sandy or porous soil. They enjoy cool air and as much indirect light as possible, but not the direct rays of the sun. The north side of a building is better for them than a station under trees, as the trees usually give too dense a shade, and their roots interfere. On the other hand, coleus is more highly colored in full sunlight than in shade.

The only fibrous-rooted begonias largely used for bedding are varieties of the semperflorens type, of which Vernon and Erfordii are popular varieties at present. In the manipulation of tender perennials, there are often two methods of propagation, either of which may be better, according to the ideal in view. As a matter of general tendency, propagation by cuttings gives bloom that is earlier but not so continuous or profuse as by seeds. Salvias and verbenas are pronounced examples. On the contrary, cuttings must be depended on, as a rule, to keep the choicest varieties true to type, as a function of seeds in nature seems to be to produce more variation than can be attained by non-sexual methods of propagation, as by bulbs or cuttings. Salvias are also an example of plants that are particularly effective when seen at a great distance, and also of plants that are generally massed for unity of effect, and not mixed with others. Verbenas are commonly grown by them-

selves, but this is because they demand much room by reason of their trailing habit.

Subtropical bedding.

Summer bedding for subtropical effects employs chiefly cannas, musas, castor-oil plants, crotons, palms, ferns of coarser habit, screw-pines, dracenas, araucarias, elephant-ear caladiums, and, to a lesser extent, abutilon, acalypha, achyranthes, anthericum, *Carica Papaya*, sanchezia, and others. Cannas are by far the most popular at the present time, especially for mass-work. Sometimes the tall, purple-leaved old-fashioned, small-flowered types are used in the center or at the back of the bed, and the dwarf, modern, large-flowered types around the edges or in front. Frequently, massing with a single variety of canna is practised. Next to cannas in popularity probably come the crotons or codieums,—the broad-leaved types, as Queen Victoria, being better for this purpose than the narrower-leaved or simply curious kinds, as *Codiæum interruptum* and *C. volutum*, which belong to fanciers' collections. For carpeting the ground in a croton bed, two variegated trailers can be used with good effect, the wandering Jew or tradescantia and *Oplismenus Burmannii*, which is familiar to gardeners as *Panicum variegatum*. The large leaves of bananas give a very rich tropical effect, especially if they can be so sheltered that the wind will not split them. One of the very best plants for encircling a public fountain is the huge-leaved elephant-ear caladium. For interesting points concerning its culture, see *Colocasia*. Among the first half-dozen favorities for sub-tropical bedding is the castor-oil plant, or ricinus. Its marvelous growth from seed in a single season makes it one of the very best of all plants for rapidly filling up large areas temporarily. Grasses furnish an exception to the general rule that bedding plants are tender. There are some kinds of bamboos that are more or less hardy in the northern states, and these are bound to increase in popularity. Figs. 487, 488. A favorite combination of grasses for bedding is *Arundo Donax*, the giant reed, surrounded by eulalias. Grasses and their kind are particularly effective in aquatic groups.

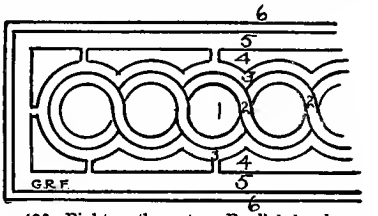


492. Tudor rose pattern.

1. Scarlet begonia. 1. Lobelia erinus, white. 3. Echeveria secunda glauca. 4. Scarlet geranium. 5. Cineraria maritima. 6. Alternanthera paronychioides.

No well-kept large establishment is complete without a pond or body of water in which aquatic plants are naturalized. For a more extended account of this attractive subject, see the article *Aquatics*.

There is a large class of tender material—as palms, screw-pines, the coarser ferns, dracenas, araucarias—a class of foliage plants that really does better outdoors during summer in a shady and sheltered position than indoors all the year round. In the more formal styles of ornamental gardening, such plants often form the nucleus of a subtropical bed, the large tubs of the palms being hidden by lower-growing plants, as begonias, or whatever may be left over from the spring operations. In less formal gardening, the tubs may be hidden by plunging them half-way into the ground and grading the sod, which has been previously broken, in such a manner as to conceal the tubs entirely. The plants are arranged in a freer and more natural manner, and the outer fringe of begonias and the like may be dispensed with. The chief dangers to such plants are from the sun and wind. Palms once scorched or wind-whipped are ruined. Hence, a sheltered position on the north side of a building, or under the shade of trees, is usually the best spot for their summer vacation.



493. Eighteenth century English border pattern.

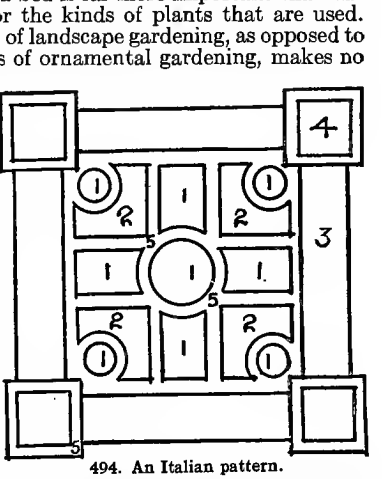
1. Lobelia erinus, blue. 2. Begonia, "Fairy Queen." 3. Cineraria maritima. 4. Calendula officinalis, "Sulphur Queen." 5. Lobelia erinus, white. 6. Alternanthera paronychioides. Alternative: Use pansies alone.

Carpet-bedding.

What is known as carpet- or design-bedding is the most formal and most expensive of all kinds of bedding, and employs plants that stand pinching and shearing, as coleus, achyranthes, alternanthera, lobelia, one of the dusty millers (*Centaurea gymnocarpa,—C. candidissima* will not bear the shears), and certain succulents of the hen-and-chickens type (as echeverias), and many others. The plants are started indoors, mostly by cuttings, and from very carefully selected stock. The terms "geometrical bedding" and "fancy bedding" are somewhat synonymous. Here belong the imitations of buildings and animals, the portraits of men, the lettered greetings to conventions, the calendars, floral clocks, and similar ingenuities.

The designs of carpet-beds are very numerous, but there are certain recognized standards. The diagrams (Figs. 489 to 494) give forms and planting material for a half-dozen unlike and regulated patterns, with harmonious color combinations. Forms of pattern-beds on the lawn are shown in Figs. 495, 496. A proper setting for pattern beds is indicated in Fig. 497. For designs and for extended cultural information, the reader is referred to the numerous German books on the subject, to Mottet's La Mosaïculture, and to a book published by Geo. A. Solly & Son, Springfield, Mass. This style of bedding requires the highest degree of technical skill, and is especially enjoyed by the Germans, whose gardeners excel in it.

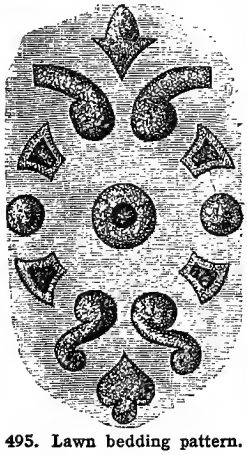
The position of a bed is far more important than the style of bedding or the kinds of plants that are used. The natural school of landscape gardening, as opposed to the various schools of ornamental gardening, makes no objection to beds in themselves, but dislikes their usual position. They are commonly given the most conspicuous places, where they must be seen, whether people like them or not. They should be in a place by themselves where they do not interfere with the quieter and larger pictures of the whole place. Sunken areas, as in Fairmount Park, Philadel-



494. An Italian pattern.

1. Calendula officinalis, "Orange King." 2. Ageratum nanum, "Blue Perfection." 3. White geranium. 4. Scarlet geranium. 5. Alternanthera paronychioides as an outline separating parts of the design.

phia, are particularly commendable; a flower-bed should not be in the middle of a large lawn, because it distracts the attention from the larger picture, and because the lawn is the canvas upon which the landscape gardener makes his picture. The chief merit of beds is their attractiveness and brightness, which accounts for their presence in parks and public places. On the other hand, they are expensive, and they are at their best only two or three months in the year, while a mud-hole in a lawn for nine months of the year is an unsightly object. Formal beds, especially of foliage plants, with their gaudy colors and unchanging monotony, are considered by some the most unnatural and the least artistic style of gardening. Nevertheless, they require a high degree of technical skill, which deserves appreciation.



495. Lawn bedding pattern.

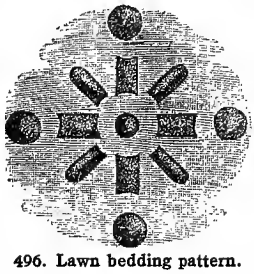
General instructions.

A few practical suggestions may be given for making any bed. The soil should be rich and full of vegetable matter. If a foot or 18 inches of the surface soil is so poor that it must be removed, it may be replaced by two parts of fibrous loam and one of well-rotted manure, with some upturned broken sods in the bottom for drainage. The fall is the proper time to apply manure, and if the bed be thoroughly spaded over and left rough during the winter, the alternate freezing and thawing will fine both the soil and the fiber of the manure. Beginners nearly always fail to supply perfect conditions for watering. A midsummer mulch of half-rotted manure enables the plants to take all the moisture they need during the drought and to keep it. The soil should be in ideal condition before the plants are set into it,—mellow, rich, full of fiber, and of firm and uniform texture. Begin in the middle and work toward the edges. When the bed is finished, give it one thorough soaking, to settle the soil at the roots.

ROBERT SHORE.

BEECH: *Fagus.*

BEES IN HORTICULTURE. Bees pollinate the greatest number of flowers of any insects. To them, therefore, horticulturists are indebted for a service that is inestimable, but it is usually disregarded. The progressive horticulturist, however, today is awake to the situation and ready to utilize the honey-bee in an effort better to meet competition.



496. Lawn bedding pattern.

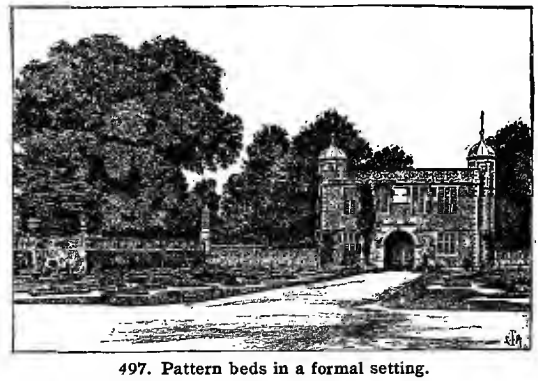
The bee's service to the horticulturist in pollinating the flowers of fruits and vegetables, is the result of its effort to secure nectar or pollen, the male element of the flower; this is transplanted from the anther to the stigma, which latter is the female organ. Many flowers, for satisfactory fertilization, require a foreign pollen, and it is through the agency of bees that this is usually supplied. The intricacies of the mechanisms and the means of pollination have been described by a host of writers, including Darwin and Müller.

There are two kinds of bees, solitary and colonial (social). Solitary bees live isolated and singly, seldom becoming numerous. Among the colonial bees are the bumblebee and honey-bee. While the honey-bee may be classed as wild when colonies escape from apiaries, wild bees may be considered to include all bees other than the honey-bee.

While wild bees are sometimes numerous and may be observed at work on the apple, raspberry and many other flowers, the honey-bee, in most localities, probably outnumbers them. If it were possible to calculate the value derived from pollination by the honey-bee alone, these returns would without doubt far exceed the total income of beekeepers through their honey and wax. In the bee, therefore, there is a source of double income.

Among the cultivated plants in northern latitudes that are pollinated by honey-bees, are the apple, pear, plum, quince, peach, raspberry, blackberry and strawberry (to some extent), mulberry, pea, bean, currant, grape, squash, melon, cucumber and the cranberry. The value of the honey-bee in the cultivation of the cranberry was but recently recognized and is mentioned on next page.

While growers of fruits and vegetables have usually recognized that bees play an important part in their croppage, they have largely depended on the wild bees or bees in neighboring apiaries for service. There is, however, some risk in this, because the seasons vary and the prevalence of insect- and bee-life varies from year to year.



497. Pattern beds in a formal setting.

It is well known that the prevalence of all wild life, plant or animal, is subject to fluctuations due to favorable and unfavorable environmental conditions. Some years in a locality there is a pest of mosquitos or houseflies. In succeeding years they may be few. It is so with the game birds and the fish of the sea; they are plenty or scarce from time to time. Bees also have their periods of ups and downs. When favored, they rise to the crest of prosperity and prevalence. It may be that disease enters a locality and reduces their numbers. Hard winters may also depreciate them so that in a year when they are needed for their service as pollen-bearers, they are at a low ebb. Fig. 498 illustrates the hypothetical curve of this fluctuation.

When the horticulturist realizes that he is depending on this fluctuating service of wild bees, he asks what he can do to overcome the unreliability and assure himself of a maximum crop or a more even crop. The recommendation would be to establish an apiary in proportion to the size of the orchard or garden. This eliminates any dependency upon wild bees or honey-bees from neighboring apiaries. Yet their additional service will do no harm. It is far better to over-supply an orchard with bees during the blooming period than to have a scarcity. Furthermore, the cost of the small apiary is infinitesimal as compared with the possible benefits and returns.

It should also be remembered that during fruit-bloom particularly, weather conditions often prohibit free flight of bees. Hence they should be near at hand to perform their service. Numerous observations are on record in which orchards were successfully fertilized when the bees had less than a quarter of a mile to fly, while more distant orchards bore no crops. Thus the apiary in or adjacent to an orchard will safeguard failure.

A specific instance of the importance of bees to the practical orchardist, is shown in an observation on two orchards of about equal acreage in a western "pocket" in the foothills of an admirable fruit land, well drained and protected from frost. One grower secured large crops, while his neighbor secured none, although his fruit trees were of the same age and blossomed heavily each spring. The owner, in despair of financial ruin, called for assistance upon the State Experiment Station. A specialist, who was a pomologist and entomologist, investigated the two entirely comparable orchards, but was about to return without solving the problem when the question of bees arose. Upon inquiry it was asserted that no bees had been maintained for either orchard. Going over the ground more carefully, however, the specialist found in a neglected corner of the fruiting orchard, a fallen log partially sunken in the damp land. This sheltered a very large colony of bees; to it is attributed the success of the orchard. The following season bees were provided in the orchard which had previously failed, with the result that the owner netted $3,800 on his crop.

Special services of bees.

Various fruits.—The honey-bee has been known to work the strawberry although it does not always frequent it. There is, however, a particular affinity in the raspberry for bees. One of the sources of the finest honey is the wild raspberry. The blackberry is less frequently visited. Plums benefit materially.

Cranberry.—Recently investigations have shown the bees to be of prime importance in the setting of cranberries. In cranberry-growing in Massachusetts, owners are maintaining their own apiaries. It may be desirable to have one colony for every two acres. The growers of melons use colonies of bees on their plantations with most marked success. Similarly, cucumber-growers for pickling-houses and squash-growers regularly maintain bees. General market-gardeners also believe in the benefits derived.

Apple and peach orchards.—Apple and pear crops as well as peach and plum are, without doubt, more even, larger and more constant when bees are kept. In Vermont it has recently been noticed that the largest apple crops occur in the vicinity of the commercial apiaries. It is fast becoming the custom among commercial growers to maintain their own apiaries adjacent to or in their orchards. Some advocate a colony of bees for every fifty trees.

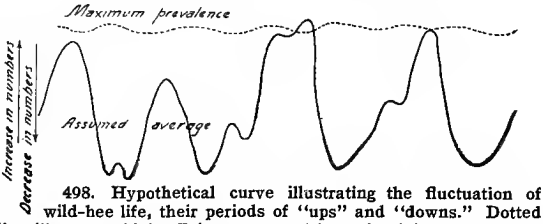
In greenhouses.—For the fertilization of vegetables and fruits in greenhouses, bees are of material service, having largely done away with the use of the camel's-hair brush, impossible for commercial growers. For example, in Massachusetts, one grower of greenhouse cucumbers uses upwards of eighty colonies a year. The total number used annually in the state by greenhouse cucumber-growers exceeds 2,000 colonies. It is believed by some that tomatoes in the greenhouse benefit to some extent by the service of bees.

The alleged injury to fruit by bees.

Occasionally it is alleged that bees damage an orchard. It might be concluded when bees are seen upon peaches, grapes or pears, sucking at the flesh, that the bee is injurious. On the other hand if this act could have been traced, it would have been found that something other than a bee had first pierced the skin of the fruit. Investigation shows that wasps and birds do this, or that a fungus may disintegrate the skin. In some such break in the skin the honey-bee can make a start; but to the satisfaction of all beekeepers and most orchardists, it has been proved by experiments and demonstrations that the honey-bee is physically incapable of puncturing a sound fruit. Thus, the injury by bees to fruit is a misconception; the news should be spread by successful orchardists.

Securing of bees.

Bees are available to horticulturists in several ways. A small number of colonies is sometimes hired for a period of a few weeks, during the blossoming period of the crop. Growers occasionally induce beekeepers to establish an apiary in their orchards by grantiog them privileges. Bee-keepers sometimes approach orchardists for the location of the apiary. The more thoughtful grower, however, considers it advisable to own his bees. These he maintains himself or hires kept by a practical apiarist. The practice is growing in favor, especially among moderate-sized orchardists or cranberry-growers, of hiring a practical apiarist to maintain the colonies on several adjacent farms. This coöperative plan insures a maximum efficiency of the colonies at a minimum cost and without burdening the horticulturist with additional detail. Those who use bees in



498. Hypothetical curve illustrating the fluctuation of wild-hee life, their periods of "ups" and "downs." Dotted line illustrates high efficiency secured by maintaining an apiary.

greenhouses will find it advantageous to maintain colonies rather than to purchase annually.

In buying bees it is particularly essential to secure disease-free stock. Bees are subject to at least two prevalent diseases, known as "American foul brood" and "European foul brood," to which they succumb rapidly. The inexperienced, therefore, should secure information and ascertain that the bees have been inspected for disease, when this is possible. Should disease set in, a considerable loss, both in bees and to the orchard, might result in a short time. Information concerning diseases can usually be had through the experiment stations or agricultural colleges as well as the United States Department of Agriculture.

Manipulation of bees.

There are numerous books and bulletins upon the manipulation of colonies. A few fundamental features are: Always keep the colonies strong; secure an amiable race so that the bees may be handled agreeably; keep the colonies in hives from which the combs may be removed; eliminate swarming; give adequate protection in winter; feed when necessary.

If the inexperienced grower is to manipulate his own bees, it is advised that he begin with a small number of colonies, say not more than five.

If the bee-moth becomes prevalent in the hive, it is a sign that something is radically wrong with the colony. An experienced apiary inspector always suspects the presence of disease when moths are found.

BURTON N. GATES.

BEET. A set of garden vegetables, grown for the fleshy roots and a few sorts for the thickened midribs; and some kinds in the ornamental garden for the highly colored foliage.

There are 4 or 5 species of the genus Beta, which are

sometimes cultivated under the name of beet, but *Beta vulgaris*, Linn., is the only one of practical importance. From it all our common garden varieties are derived. According to DeCandolle, the aboriginal slender-rooted species is found in sandy soil, and especially near the sea, throughout southern Europe, and on nearly all the coasts of the Mediterranean. It also occurs as far eastward as the Caspian Sea and Persia. "Everything shows that its cultivation does not date from more than two or three centuries before the Christian era." It is now highly improved, principally in the one direction of large and succulent roots, and is much esteemed in all civilized countries. See *Beta*.

499. Bassano beet.

The beet grows at a low temperature and thrives best, therefore, in the cooler parts of the country. It is also an important winter crop at the South and an early spring crop at the North. The young plants will stand light frosts and after two weeks will stand fairly heavy frosts.

With the extension of glasshouse gardening, beets have come to be one of the important greenhouse crops. They are not usually made a main crop, however, but are grown between other crops, such as lettuce, beans, or even tomatoes. They are sown very thick and when the young plants begin to crowd, they are thinned out and the thinning sold for greens. As beets thrive best at relatively low temperatures, they may first be grown in a lettuce-house or other greenhouse having a temperature of 60° to 70°, rather than in a house piped for tomatoes or cucumbers.

The beet is grown exclusively from seed. Most table-beet seed for use in the United States is produced in Europe. It is possible, of course, for any gardener to grow his own seed, but in order to do this the roots must be taken up before the crown is exposed to severe frost, and carried through the winter in cool and moist but frost-proof storage, and planted in the garden the second year. Seed stems run up to the height of 4 feet. When the seeds are ripe the tops are cut and put in a warm storage house to dry. When fully dry the seed is winnowed out. Seed is usually sown where the crop is to grow, although the plants are easily transplanted. The transplanting is sometimes undertaken, especially when beets are to be grown as a catch-crop or intercrop in greenhouses.

Varieties and types.

Some of the most popular varietal types of the garden beet are: *Bassano* (Fig. 499).—Flesh white and light red mixed; an old-time early variety, now less grown than formerly. *Crosby.*—Slightly oblate, red flesh, excellent for general purposes, including forcing. *Early Blood Turnip.*—Rich, deep blood-red, flattened turnip-shape; an old and well-known sort. *Edmand.*—Moderate size; handsome, rounded, smooth, deep red; good grain and flavor; not quite first-early. *Eclipse.*—Uniformly globular, bright red; fine-grained and sweet; one of the best quick-growing early beets. *Egyptian Turnip.*—Tops quite small; roots fair size, rich, deep red; a standard early variety.

For field culture of culinary beets, the long-rooted varieties are chiefly used. These are sown in the field as soon as the weather is settled, in rows far enough apart to allow of tillage by horse. Most of them require the entire season in which to mature. They are grown mostly for storing for winter use. They were once grown for stock, but the mangel-wurzels give much greater yields. The various types of Long and Half-long Blood beet (Fig. 500) are chiefly used for field culture.

Favorite varieties of mangel-wurzels are Golden Tankard, Golden Yellow Mammoth, Mammoth Long Red. Several sorts of sugar beets, mostly imported from Germany, are being grown in divers places in America. Of chard, there are few selected varieties offered in America.

The varieties of *Beta vulgaris* may be conveniently divided into five cultural sections, though the distinctions are somewhat arbitrary and of no fundamental importance. These sections are as follows:

1. Garden Beets. Varieties with comparatively small tops: roots of medium size, smooth, regular and fine-grained: mostly red, but sometimes whitish or yellowish.

2. Mangel-wurzels, or Mangels. Large, coarse-growing varieties, with large tops and often very large roots, the latter frequently rising some distance out of the ground; rather coarse-grained. Extensively grown for stock-feeding. See Cyclo. Amer. Agric. Vol. II, p. 539 (Root Crops).

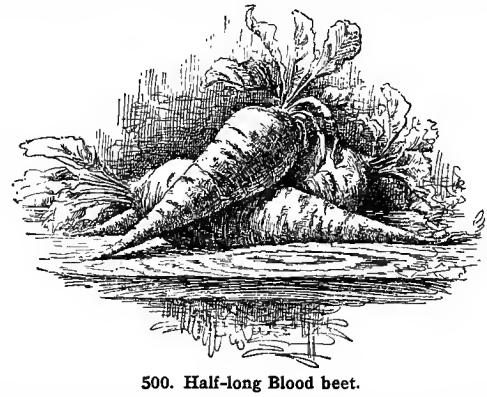
3. Sugar-Beets. Sometimes said to belong to another species, but doubtless to be classified here. Rather small-growing varieties, with medium tops: roots small to medium, usually fusiform, smooth, nearly always yellowish or whitish. See Cyclo. Amer. Agric. Vol. II, p. 588.

4. Chard, or Swiss Chard. Varieties with comparatively large tops, broad leaf-blades and very large, succulent leaf-stems, which are cooked and eaten somewhat like asparagus. The thrifty, tender young leaves make a very excellent pot-herb. Chard has sometimes been referred to a separate species, *Beta Cicla*, but should be included with *B. vulgaris*. See *Chard*.

5. Foliage Beets. A race which has been developed to produce luxuriant foliage of many colors and varied markings. Of such varieties are the Brazilian, Chilian, Victoria, and Dracæna-leaved. The ribs of the leaves are usually beautifully colored. Where the leaf-blight fungus is not serious, these foliage beets make excellent borders when strong and heavy effects are desired, and they are excellent for bedding. Raised from seeds, as other beets are; roots may be kept over winter.

Cultivation.

Young beets constitute one of the most important early crops in truck-gardening. Many acres of them are grown near all the city markets, and as they bear transportation well, they are often grown at comparatively remote places. Large quantities are shipped early from



500. Half-long Blood beet.

Norfolk, Va., and from other southern points to northern markets. Like all root crops, the beet needs a loose, light, fresh, clean, rich soil, which must be in the best condition of tillage. No fermenting manure should be used, but instead fully rotted barn manure, with some good potash fertilizer. Light applications of nitrate of soda often produce marked beneficial effects. The seed for the first crop is sown early in spring, as soon as the soil can be well worked. When intensive garden-

ing is practised, the drills may be as close as 1 foot apart, in which case the young beets are thinned to 6 inches apart in the row. But in ordinary gardening, it will be found most convenient to run the rows 2 to 3 feet apart, allowing cultivation with the horse. The plants in such rows can be left 4 inches apart at thinning time. The thinning is done when the young plants are large enough to be pulled for "greens," for which purpose they find a ready market. Beets are also grown in quantities as a fall crop, and are stored for winter use. When this is to be done, the seed is sown in June, and the plantation is managed in all respects like the spring sowing. When the young roots are ready for the early market, they are pulled and tied in bunches of five or six. The fall crop is pulled soon after the first frost, the tops are removed, and the roots stored in pits or root cellars.

Marketing.

Greenhouse beets and early beets are usually bunched for market, three to six together, according to size. They are bunched together tightly with a string about the tops. All beets should be thoroughly washed before marketing. Considerable quantities of late beets and field-grown stock are sold in bulk, like potatoes. In this case the tops are cut off. Late-grown beets may be stored over winter in the same manner as potatoes. They are often buried in the fields in pits, but may be kept in a good cellar or storage house. The yield of mature beets varies from 200 to 500 bushels to an acre, 300 being an average yield.

Insects and diseases.

There are many species of insects that feed upon beets, but flea beetles are about the only ones of importance. These may be poisoned by spraying with paris green or arsenate of lead, and they are driven away in many cases by the use of bordeaux mixture which is also the most important preventive of leaf-spot. This leaf-spot is perhaps the worst disease which attacks beets, but this is more common upon the sugar-beets in the field than upon the more common varieties. The potato scab, very common on potatoes, is found also on beets, and as this disease lives in the soil from year to year, it is a bad practice to grow beets after a crop of potatoes.

F. A. WAUGH.

BEGÒNIA (named after Michel Begon, superintendent at St. Domingo, 1638–1710, a French promoter of botany). *Begoniàceæ*. BEGONIA. ELEPHANT'S EAR. BEEFSTEAK GERANIUM. A various group, ranging from hothouse to conservatory and window-garden subjects, many of them grown primarily for foliage, others for the showy bloom; treated mostly as single pot-specimens, but some kinds used for bedding.

More or less sappy or succulent herbs or undershrubs, having the st. in some cases reduced to a thick rhizome, in others to a distinct small tuber, while a few others possess a semi-tuber in which there are a number of closely set scales or suppressed lvs., resembling bulbs: lvs. variable, alternate, more or less unequal-sided, entire, or lobed, or toothed, ovate-acuminate, orbieular or peltate: fls. monœcious (bisexual variations are known: Dümmer, Annals Bot. xxvi. 1123), asymmetrical, usually in axillary cymes, the males usually with 4 parts, of which 2 are mostly small, the females with 5 (rarely 2), pink, white, rose, scarlet, yellow, and all shades of these, being represented; stamens numerous; filaments free or united at the base; styles 2 or 4, free, sometimes connate; stigmas branched or twisted like a corkscrew; ovary inferior: fr. usually a 1–3-winged caps., which is often colored; seed numerous, very minute.—The genus Begonia, with 400–500 species in warm countries around the globe, gives the name and definition to the Begoniaceæ. Only three other genera are recognized: Hillebrandia, with 1 species in Hawaii; Symbegonia, 1 little-known species in New Guinea; Begoniella, 3 species in Colombia. The begonias are exceedingly variable, the genus running into about 60 well-marked sections, but the intergradations are so many and the essential floral characters so constant that it is impracticable to break up the great group into separate genera.

The begonia is one of the great groups of cultivated ornamental plants. Very many species have been introduced, and there are numberless hybrids and variations. The most popular single begonia is now probably the wonderfully floriferous Gloire de Lorraine (Fig. 505). The foliage begonias are of many original kinds, and the numerous hybrids and variations have given great choice to the cultivator. *B. Rex* is the chief basis of the foliage races. Many cultivators are unaware of the possibilities of the Rex derivatives, because they grow them in pots (for commerce) on benches, whereas the singular and characteristic results are secured by growing them in the earth against greenhouse walls or in rock pockets below the benches (Plate XIV).

Because of the great numbers of interesting forms, begonias have appealed strongly to collectors and fanciers. In recent years, however, the collections have been passing out in the large private places; and most dealers now carry only a few standard kinds (mostly modified cultivated forms), in addition to the florists' bedding and garden sorts and a general mixed stock of tuberous kinds. The following botanical account, therefore, does not accurately represent the present state of the begonia trade. It is to be regretted that the fanciers' collections are not kept; and it is partly in the hope that the desire for collections will return that this rather full treatment is given of the main species and stem-groups now in cultivation.

The foliage begonias of the Rex type are subject to an insidious disorder, affecting the leaves and eventually the entire plant. The remedy seems to be to discard all suspected stock and to propagate from wholly healthy plants, or to grow them out of it by planting them in a shaded airy greenhouse bench for a summer and potting again in fall.

The interest in begonias centers in their use as ornamental subjects. It is said that the stalks of some of the species are used as the leaf-stalks of rhubarb are used. The rhizomes of many species, particularly those from South America, are bitter and astringent and are employed locally for certain fevers and for syphilis. Some species contain purgative principles. The sour sap of one of the Asiatic species is said to be used for the cleaning of weapons.

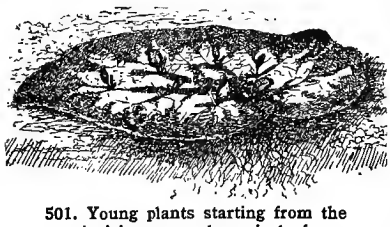
The first begonia was introduced into England in 1777, *B. nitida*. Since then, about 200 have proved of value to the horticulturist. Few other plants have been improved or varied so rapidly, there being thousands of variations now in cultivation, displaying the most gorgeous colors in their flowers and beautiful coloring in their leaves. The development of the modern race of hybrid tuberous begonias followed the introduction of *B. Veitchii, B. rosæflora, B. Davisii, B. boliviensis, B. Pearcei* and others after 1860. The geographical distribution of begonias is very disjunctive and localized. They are indigenous to Mexico, Central and South America, Asia, and South Africa. They seem to have no genetic relationship with other plants now living. For literature, see Dryander, The Genus Begonia, Trans. of the Linn. Soc., Vol. I, 1791; Klotzsch, Begoniaceen-Gattungen und Arten, 12 plates, 1855 (Abh. Ak. Berlin); DeCandolle's Prodromus, 15, 1, 1864; and floras of regions in which begonias are native.

L. H. B.

General culture and propagation.

For horticultural purposes, the begonias may be arranged in four groups: The socotrana or semi-tuberous set; the tuberous-rooted; the foliage kinds, mostly

rhizomatous; and the fibrous-rooted. The bedding begonias are mostly of the fibrous-rooted section, particularly in the Semperflorens group, although the improved tuberous kinds may be used for this purpose in special places.

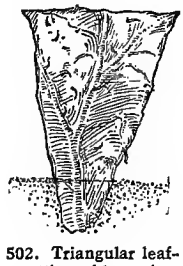


501. Young plants starting from the incisions on a begonia leaf.

(1) The semi-tuberous or bulbous group comprises such begonias as *B. socotrana* and Gloire de Sceaux. They require much care and should be grown in a soil with more leaf-mold than the fibrous-rooted, and a temperature of 65° to 70° in the daytime and 60° at night. Of Gloire de Sceaux and some others, plants two years old will be found best for decorative purposes. For special notes on *B. socotrana*, see the treatment of that species, page 473.

(2) The tuberous begonias are grown in pots, boxes or baskets, under glass, or as bedding plants in a shaded border. If the plants are intended for pot-culture in the greenhouse, it is best to use the tubers. For early flowering, start the tubers in February or March, either in small pots or shallow boxes. The soil may be composed of loam, sharp sand and leaf-mold, and the temperature about 60° to 65°. When the plants are ready for repotting, well-rotted manure may be added, and when the roots have taken a fresh hold a cooler temperature may be maintained. For bedding purposes, seedling plants, as well as tubers, may be used, providing they are of a first-class strain. Tubers are preferred if early-flowering plants are desired. For further cultural notes, see the discussion on page 471.

(3) The Rex begonias are grown entirely for the beauty of their foliage. They may be propagated by means of either shoot- or leaf-cuttings, the latter being the better when plants have to be raised in quantity. Large and well-matured, but still healthy and vigorous leaves may have the principal nerves cut on the under side. The leaf is then pegged or weighted down on the surface of a well-drained propagating bed. If carefully shaded, roots will be formed at every cut, a tiny leaf will follow (Fig. 501), and the little plants may be inserted singly in small pots. Another method is to cut the large leaves into triangular parts, with a bit of the main petiole at the tip of each, and insert the pieces about 1 inch, with the lower or thickest end of the rib downward (Figs. 502, 503). Still another method is to cut the leaf in two, across the veins, and stand it edgewise in the propagating bed. The young plants may be potted-up into small pots, using a light, porous, sifted soil. Keep shaded in a low house with a moist atmosphere. The soil may be gradually made coarser with each potting until in the final shift; an unsifted compost of two parts loam, one part leaf-mold, one part well-rotted manure, and one part sand, is used, adding a sprinkling of lime. While watering, avoid wetting the leaves as much as possible, and keep large, well-developed plants in a shaded house, with plenty of ventilation day and night during the summer.



502. Triangular leaf-cutting of begonia.

(4) The fibrous-rooted begonias comprise such species as *B. nitida*, *B. semperflorens* var. *gigantea*, *B. albopicta*, *B. Haageana*, and *B. Duchartrei*. Of these, cuttings taken from clean, healthy stems in spring will strike readily in an ordinary propagating-box or bench, and if potted-on, as they require root-room, will make fine plants for late winter and spring flowering. As soon as one neglects good treatment, especially in regard to light, fresh air and fresh soil, the red spider, a physiological disease appearing like rust, and the dreaded nematodes, will soon attack them and give them a sickly and stunted appearance. They require a temperature of 55° to 60° at night and 65° to 70° in the daytime. The plants should be kept close to the glass in the early stages of growth, on account of the tendency of many of the varieties to send out rather long shoots. A good compost is three parts loam, one part well-rotted manure, and one part sand.

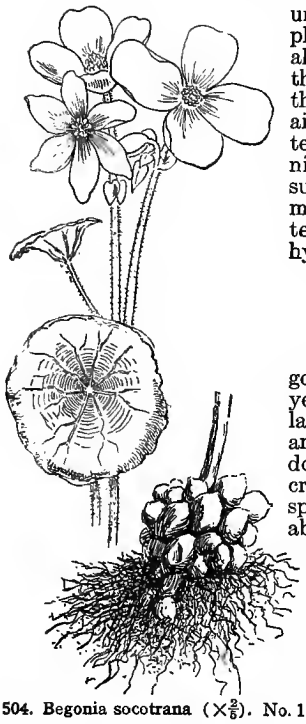
While begonias in general are injured by too strong sunshine during summer, they are benefited by all the sunshine they can get during the winter and early spring months. Strong sunshine, however, pouring through imperfect glass upon wet foliage, is liable to blister the leaves of any begonia. Such species as *B. Dregei* and *B. weltoniensis*, which produce at their base a thickened, fleshy stem like a potato, may be propagated either by division or by cuttings. Many kinds of the fibrous-rooted and rhizomatous sections can be grown by amateurs, and make excellent house-plants, especially *B. manicata*, *B. coccinea*, *B. speculata*, *B. argyrostigma* var. *picta*, *B. ricinifolia*, *B. heracleifolia*, *B. incarnata*.

ROBERT SHORE.

Begonia Gloire de Lorraine.

Begonia Gloire de Lorraine (Fig. 505) was raised by Lemoine by crossing *B. Dregei* and *B. socotrana*, and is one of the most useful and beautiful decorative plants introduced. If large specimen plants in 10- or 12-inch pans are desired, propagating should be begun about November or December of the year previous, as these plants are generally at their best about Christmas time. The best plants are obtained from leaf-cuttings. Select medium-sized, well-ripened leaves, cut off with a sharp knife, insert in a bed of sharp sand in a temperature of 70° and space them far enough apart, so that they do not touch one another. The propagating-bed should be at least 2 inches deep, but the stems should not be buried so deeply that the leaf lies on the top of the bed. These precautions prevent damping off. A further preventive against damping off is to dust powdered charcoal over the bed after the cuttings have been thoroughly watered. The leaf-cuttings of Gloire de Lorraine are far superior to shoots that start from the base of a cut-back plant, the leaf-cutting having greater vigor and breaking more shoots from the base of the plant. The leaf-cuttings will root in three weeks in the temperature recommended above, but they should be left in the sand until they begin to throw up shoots from the callus formed at the end of the leaf-stem, after which they should be immediately potted in 2-inch pots, in equal parts of fibrous loam and leaf-mold, with about a fourth part of charcoal. Never allow the plants to become pot-bound until they have attained the desired size, and for all future pottings use equal parts of the fiber of loam, half-decayed flaky leaves, well-rotted cow-manure or horse-droppings, and a fourth part of charcoal. Use this compost as rough as can be conveniently worked around the plant while potting. During the summer, they should be grown in a rather humid atmosphere near the glass, always lightly shaded from the sun until they begin to flower. Pinch the shoots two or three times during the season as this encourages breaks from the base of the plant. When well rooted in the final shift, waterings with manure-water will be beneficial. When the plants begin to flower, they should be neatly staked with thin twigs,

503. Plant arising from the base (or tip) of a triangular leaf-cutting.



504. Begonia socotrana (×⅔). No. 1.

unless desired for hanging plants, when they may be allowed to droop around the pan. When in flower they should be in a light airy greenhouse with a temperature of 45° by night. These plants are subject to mealy-bug and may be fumigated at intervals of two weeks with hydrocyanic gas.

GEO. F. STEWART.

Tuberous begonias.

The tuberous-rooted begonias, which are every year becoming more popular, both as pot-plants, and for bedding out-of-doors, are the result of crossing several different species differing considerably in habit, and are easily cultivated. They are raised almost wholly from seed, and good strains in different colors may be obtained from any reputable seed firm. However, if one wishes to increase these plants by cuttings it can be done. Shallow boxes or seed-pans may be used in which to sow the seed about the beginning of February. They should be well drained and filled with a compost made up of equal parts of peat, leaf-mold and about a fourth of charcoal. As soon as the plants are large enough to handle, prick them out about 2 inches apart in the same soil as above, place them close to the glass, but always shaded from the bright sun, and in a moist atmosphere. When they have grown close together, transfer them to 3½-inch pots, the best soil to use from now on being a spent mushroom bed, adding about a fifth part of charcoal. A 6-inch pot is generally large enough for the first season, and when they are well established in these pots should be kept as cool as possible. A house facing north is the best place for them during the summer, and all the air possible may be admitted night and day. On no account allow these plants to suffer for lack of water until fall, when they will begin to show signs of ripening off. During their growing period, they may be stimulated by frequent applications of cow-manure water, and soot diluted in water, an ordinary handful to two and a half gallons of water; water three times with clean water, and alternately with the other two. When signs of ripening begin to show, gradually withhold water until the growths decay, and then place the pots on their sides under a bench in a greenhouse where the temperature keeps around 40°. Be sure they are in a position where water does not reach them. The tubers will be good for several years, but the best plants are in their second year. The plants may be started at intervals, having an earlier and a later lot. For bedding out in partial shade, these plants have no equals. Start the tubers in flats about the end of April, have the bed heavily manured and the soil level with the surface of the ground, as the roots run near the top of the ground, and consequently they have to be watered frequently. The top of the bed should be always moist, a mulching of well-rotted manure being of great assistance in retaining the moisture. Plant about a foot apart, all of one color, unless great care is exercised in blending the brilliant colors so that they do not clash.

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505. Begonia Gloire de Lorraine. No. 2.

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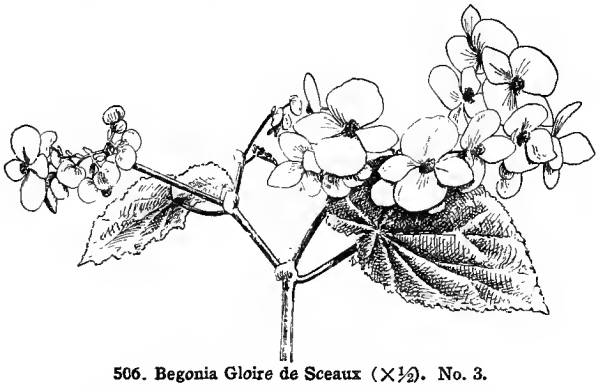


506. Begonia Gloire de Sceaux (×½). No. 3.

Horticultural Arrangement of Species.

This arrangement often throws together species of no close botanical relationship, but it will aid the cultivator to understand the genus.

I. Species Bulbous or essentially so.
socotrana.

II. Species Tuberous.
A. *Plant stemless, lvs. springing directly from the crown or tuber (Davisii, rosæflora, Froebelii, Veitchii, octopetala.)*
AA. *Plant with sts., more or less branching.*
B. *Lvs. narrow (lanceolate to ovate-lanceolate) (boliviensis, Sutherlandii).*
BB. *Lvs. broad (ovate to cordate-ovate) (Pearcei, Clarkei, Evansiana, gracilis, Dregei, weltoniensis, fulgens).*
BBB. *Lvs. orbicular (Baumannii).*
BBBB. *Lvs. various, mostly broad-ovate at base, acuminate (tuberhybrida).*

III. Species Rhizomatous.
A. *Plant creeping, trailing, or climbing (glaucophylla, scandens).*
AA. *Plant upright, often diffuse.*
B. *The picture-lvd. species, grown for the foliage, which is large and prominent and blotched, strongly colored, blistered, or otherwise illustrated. The Rex set, and others.*
C. *Lvs. oblique, lobed at the base, not peltate (or only slightly so) (Rex, xanthina, Griffithii, Rajah, Augustinei, dædalea, speculata, decora, imperialis).*

CC. *Lvs. markedly peltate (modica, Gentilii, Binotii, goegoensis).*
BB. *The essentially plain-lvd. rhizomatous kinds, although some of them are grown chiefly for foliage.*
C. *Lvs. prominently lobed, or parted or even divided (ricinifolia, heracleifolia, Sunderbruchii, rubella, Verschaffeltiana, heracleicotyle).*
CC. *Lvs. lanceolate to ovate or cordate-ovate to orbicular, not deeply lobed, often entire, and sometimes peltate.*
D. *Foliage small, the lvs. less than 2 in. wide (hydrocotylifolia).*
DD. *Foliage of usual or large size.*
E. *The lvs. peltate (Feastii, nelumbiifolia, conchæfolia, Lubbersii, albo-coccinea).*
EE. *The lvs. not peltate (manicata, leprosa, magnifica).*

IV. Species Fibrous-rooted (*Rhizomes small or 0.*)
A. *The herbaceous kinds—the plant small, succulent, never becoming very tall or woody (semperflorens, gigantea rosea, Carrierei, Erfordii, Lyncheana, Lucianæ, Corbeille de Feu).*
AA. *The woody or shrubby kinds, usually much branched when mature, and often tall.*
B. *Kinds slender, upright, small-leaved, mostly smooth, green or nearly so: lvs. many and usually not more than 1 in. across.*
C. *Fls. pink or red (fuchsioides, Ingramii, Digswelliana, incarnata, ascotiensis).*
CC. *Fls. white, or tinted white (foliosa, knowsleyana, acuminata, albo-picta).*
BB. *Kinds low-growing, diffuse (Schmidtiana).*
BBB. *Kinds stiff, succulent white-scurfy (peltata, venosa).*
BBBB. *Kinds mostly tall and erect, some of them becoming 8 ft. high, distinctly shrubby and bushy.*
C. *Lvs. compound, or divided (luxurians, Hemsleyana, platanifolia, digitata, caroliniæfolia, diadema).*
CC. *Lvs. not compound, although sometimes strongly notched or even lobed).*
D. *Whole plant hairy, or at least so much so as to give it the appearance of being a rough or pubescent species.*
E. *Foliage light green and plant pubescent (vitifolia, Engleri).*
EE. *Foliage markedly colored above or beneath, or both.*
F. *Fls. white (echinosepala, erythrophylla, Scharffiana, Duchartrei).*
FF. *Fls. colored (Haageana, Credneri, Alleryi, Margaritæ, metallica, cathayana, deliciosa, laciniata).*
DD. *Whole plant smooth or becoming so (a few hairs perhaps remaining on the lvs.), or so much so as to give it the appearance of being a glabrous species.*
E. *Lvs. medium to large, very broad, fleshy or thick, entire, often peltate (sanguinea).*
EE. *Lvs. medium size, stiff, green and shining, often elongated, mostly undulate or notched.*
F. *Fls. white (angularis, ulmifolia, longipes, undulata, kewensis).*
FF. *Fls. colored (nitida, Teuscheri, Bismarckii, carminata, polyantha, coccinea).*
EEE. *Lvs. medium to large, the margins strongly toothed, incised or lobed.*
F. *Fls. white (Madame de Lesseps, olbia).*
FF. *Fls. colored, varying to tinted white (argenteo-guttata, maculata, Thurstonii, dichroa, coronata, phyllomaniaca, President Carnot, lucerna).*

I. Bulbous Begonias, and Semi-Bulbous or Semi-Tuberous Derivatives.

1. **socotràna**, Hook. Fig. 504. A winter-flowering species: st. annual, stout and succulent, forming at the base a number of closely set scales or suppressed lvs. resembling bulbs: lvs. dark green, orbicular, peltate, 4–7 in. across, center depressed, margin recurved,

crenate: fls. all male except the terminal one of each branch of the cyme, in terminal few-fld. cymes, bright rose G.C. II. 15:8. B.M. 6555. Gn. 21:163; 49:426 (as *B. Gloire de Lorraine*). J.H. III. 51:317. R.H. 1906, p. 130; 1909, p. 426. A.F. 13:587, 588.—Bulbs or semi-tubers were brought from the hot sandy island of Socotra by I. B. Balfour, and grown at Kew in 1880. The species was first described in Gardeners' Chronicle in 1881, and in the same year in Botanical Magazine. See also Balfour, Botany of Socotra, p. 102, 1888 (Vol. 31, Roy. Soc., Edinburgh). An early study of the nature of the bulbs by Duchartre will be found in Bull. Soc. Bot. de France, 12 (1885).—This excellent plant requires to be grown in a light position in a stove to develop at its best. The bulbs should be shaken out of the old soil in Sept. or Oct. and potted up in a light soil, rich in humus, and placed in heat and moisture, and, when well established, should be liberally supplied with manure-water. The fls. appear during the winter months, after which the plant dies down, forming a number of large resting buds or bulbs; the pots should then be placed in an intermediate temp. and be kept nearly dry until the following growing period comes round. On account of its habit of producing fls. in winter, this species has been largely used by the hybridist in the production of a race of winter-flowering begonias, of which there are many named varieties.

507. Begonia Davisii (×⅓). No. 6.

Following are leading Socotrana derivatives:

2. **Gloire de Lorraine** (*B. socotrana* × *B. Dregei*). Fig. 505. One of the finest hybrid begonias ever raised: lvs. small, nearly regular, pure green: fls. almost exclusively male, 4-petaled, large, borne in broad panicles, covering the whole superior part of the plant, rose-colored, not deciduous. Gt. 42, p. 111. A.F. 12:842. G.F. 5:247.—Although *B. socotrana* is semi-bulbous and *B. Dregei* has a thickened rhizome, the hybrid forms show neither, but the base of the st. throws out many shoots, which can be separated and insure the multiplication of the plant. Intro. by Lemoine in 1892.—There are several forms of this plant now in cult. *Rothschilds* variety has larger and darker colored fls. than the type. *Turnford Hall* is a form with white fls. *Caledonia* also has white fls. but is far inferior as a garden plant to that of *Turnford Hall*. *Glory of Cincinnati*, a form with very lasting large satiny pink fls., is a seedling from B. socotrana × a sport of Gloire de Lorraine; it bloomed first in Dec., 1908, and was intro. to trade in 1910 (J. A. Peterson).

3. **Gloire de Sceaux** (*B. socotrana* × *B. subpeltata*). Fig. 506. Plant stout, half shrubby, erect, vigorous, compact, will form a plant as much as 8 ft. high in a year with good cult. and produce quantities of its large rose-colored fls. over a period of several months: lvs. dark metallic green, thick, large, red beneath, veins red above, suborbicular, slightly oblique: fls. profuse, beautiful rose-pink, shiny, females the last fl. on the cyme. Fls. from Dec. till May. R.H. 1884:516. G.F. 7:185.—Intro. in 1885.

4. **Triomphe de Lemoine** (*B. socotrana* × *B. Roezlii*). St. herbaceous, spreading, then erect and branching into numerous flowering branches: lvs. large, coriaceous, orbicular, somewhat oblique, margins slightly cenerous, 6 in. diam.: fls. in dichotomous cymes from axils of lvs., rose-carmine, female fls. exceedingly rare, males very profuse, plant resembling a large bouquet when in full bloom. G.F. 2:557.—Intro. by Lemoine in 1887. Retains its fls. after they are withered, a rare occurrence in begonias. Another hybrid from the same parent is *Triomphe de Nancy*, with fls. rich yellow in the center, double, and the outer petals of a paler hue.—Intro. 1888.

5. **incomparábilis,** Hort. (*B. socotrana* × a garden tuberous form). Lvs. large, with the showy, well-formed orange-red fls. standing well above them. R.B. 33:60.

II. Tuberous Begonias, *the plant passing the winter as a dormant tuber Nos. 6–30.*

A. *Plant stemless: lvs. springing directly from the crown or tuber.*

6. **Dâvisii,** Veitch. Fig. 507. Lvs. ovate-cordate, dull green, thinly hairy, above and below, upper side lighter veined and under side red, petiole short: peduncles, pedicels and fls. bright red. Peru. B.M. 6252. F.M. 1876:231. G.C. II. 15:669.—A favorite with hybridists, because of its rich coloring and its free flowering. It has given rise to numerous dwarf, erect-habited garden forms, with small but brightly colored fls.

7. **rosæflòra,** Hook. Stout: petioles, scapes, bracts, and stipules bright red: lvs. green, 2–4 in. wide, on stout, hairy petioles, 2–6 in. long, orbicular, reniform, concave, margins lobed, red, toothed: fls. 2 in. across, rose-red. Andes of Peru, 12,000 ft. Intro. in 1867. B.M. 5680.—Light-colored seedlings of this species gave rise to Queen of Whites, put into commerce in 1878, and apparently an important factor in subsequent garden forms of the same color. The species itself is probably not now in cult.

8. **Froèbelii,** A. DC. More or less hairy: lvs. numerous, cordate, acuminate, green, covered with fleshy, purplish hairs: fls. in tall, lax, drooping, branching cymes, brilliant scarlet, large. Late autumn and winter. Ecuador. J.H. III. 32, p. 33. Journ. Roy. Hort. Soc. 19, p. cxcii. Gn. 12, p. 376. Intro. about 1872–3 by Otto Froebel of Zurich.—A beautiful flowering plant, useful for conservatory work in winter. Var. **vernàlis,** Hort., hybrid (*B. Froebelii*×*B. Dregei*), similar to type; intro. by Deleuil in 1880. Var. **nàna,** Hort. Very dwarf: fls. dark scarlet.

9. **Vèitchii,** Hook. Loosely hairy: st. very short or practically none, thick, fleshy, green: lvs. orbiculate, cordate, lobed and incised, margins ciliate, green, principal veins radiating from a bright carmine spot near the center, under side pale green; petiole thick, terete pilose: fls. 2¼ in. diam., cinnabar-red: caps. smooth, unequal wings. Peru, 12,000 ft. B.M. 5663. F.S. 22:2326.—One of the progenitors of the tuberous race. Intro. 1867. Probably not now in cult., but a beautiful species.

10. **octopétala,** L'Her. (*B. grandiflòra,* Knowl. & West). Lvs. on long, succulent downy petioles 1½ ft. long, cordate, deeply lobed and serrated, bright green: fls. seldom produced in cult., greenish white, in corymbs, males with 8 or 9 petals 2 in. across, females smaller and generally fewer. Intro. to Glasgow from Lima, Peru, in 1835. B.M. 3559. F. S. 20: 2056–7. A. F. 4:225 (var. *Lemoinei*). This species is of little or no horticultural value.

508. Begonia boliviensis (×⅙). No. 11.

AA. *Plant with st. (not scapes) evident and more or less upright, usually branching.*

B. *Lvs. narrow, lanceolate to ovate-lanceolate.*

11. **boliviénsis,** A. DC. Fig. 508. Plant sparsely

hairy: st. erect at first, but drooping and becoming slender with age, 2–3 ft. high, branching: lvs. lanceolate to ovate-lanceolate, acuminate, serrate, 3–5 in. long: fls. in drooping panicles, cinnabar-scarlet, long and fuchsia-like; males twice as long as females. Bolivia. B.M. 5657.—Intro. into England in 1864. It is a very useful basket-plant. This species has recently been crossed with some of the double and single garden forms of the tuberous race (of which this species was one of the ancestors), and has given rise to a pretty and distinct type with long pendulous sts. and drooping fls. which render them most useful as subjects for baskets. **B. Bertínii,** Hort., is closely allied, and perhaps a form of *B. boliviensis.* Fls. light scarlet, numerous and large, not so pendent. Gt. 51, p. 550, desc. R.H. 1894, p. 247. There is a dwarf form (var. *nàna*) of this. **B. Worthiàna,** Hort., said to be a seedling of *B. boliviensis,* with larger and shorter lvs. and more numerous and less pendent fls. **B. bolidàvis,** Hort., is a hybrid of *B. Davisii* and *B. boliviensis.*

12. **Sùtherlandii,** Hook. Slender and graceful, 1–2 ft. high, bright vinous red, from small tubers: lvs. 4–6 in. long, lanceolate, lobed and serrated, green, with red veins and margin; petioles slender, red: fls. numerous, coppery or salmon-red. Natal. B.M. 5689.—Intro. by Backhouse in 1867. Of little decorative value.

BB. *Lvs. broad-ovate to cordate-ovate.*

13. **Pèarcei,** Hook. Pubescent, branching, 1 ft. high: lvs. oblique-ovate, cordate, acuminate, toothed, glabrous and velvety green above, tomentose beneath, pale red on under surface: fls. in loose, axillary panicles, large, bright yellow. Bolivia; intro. from La Paz, being sent by Mr. Pearce, collector for Messrs. Veitch. B.M. 5545.—A variable plant, both in habit, size, color of the fls. and in the degree of the venation of the strongly nerved lvs. It is the only yellow-fld. tuberous begonia in cult. It has been the chief factor in the production of the hundreds of yellow, buff and orange-colored garden forms. Intro. in 1865.

14. **Clàrkei,** Hook. Stout and erect, 2 ft., puberulent, the st. purplish, fleshy: lvs. obliquely cordate-ovate, serrate: fls. in pendulous racemes, abundant, large, bright red. Bolivia, 9,000–10,000 ft. B.M. 5663 (as *B. Veitchii*), 5675.—Resembles *B. Veitchii.* It was the seed parent of Vesuvius and Emperor, two important and useful varieties for bedding out. Probably not now in cult.

510. Begonia tuberhybrida. Single-flowered (×¼). No. 21.

15. **Evansiàna,** Andr. (*B. discolor,* R. Br. *B. grándis,* Dry.). Smooth: st. deciduous, branching, 2 ft. high: lvs. ovate-acute, subcordate, lobed, margins denticulate, green above, under side and petioles red, peduncles branching, axillary: fls. numerous, flesh-colored, large. Java, China, Japan. B. M. 1473.—A handsome and almost hardy species. Intro. in 1804 to Kew. Little cult. now. It makes a pretty and free-flowering plant for the cool greenhouse in summer. Readily prop. by bulblets, which are produced in quantities in the axils of the lvs. after flowering, and which will give flowering plants the following year. Stands some frost.

16. **grácilis,** HBK. (*B. bícolor,* Wats. *B. diversifòlia,* R. Grah.). Smooth and shining, tall and st. erect, seldom branched, succulent: lvs. thinly scattered along sts., almost heart-shaped, slightly hairy, lobed, denticulate, ciliate: fls. on short, axillary peduncles, pink. Mex. B.M. 2966.—In axils of lvs. between stipules a cluster of bulblets is borne. These may be gathered and sown as seeds. Along with its varieties, **annulàta, diversifòlia, Martiàna,** and others, it makes a very beautiful summer-flowering greenhouse begonia. —Intro. by P. Neill, of Cannonmills, Edinburgh, in 1829. This species should be treated in exactly the same way as the garden race of tuberous begonias as to cult. The variety *Martiana* is a large-fld. form with rose-colored fls. and frequently reaches 5 ft. in height. It is a pretty and desirable greenhouse plant, producing a succession of fls. for 2–3 months during the summer.

509. Begonia Dregei (×⅙). No. 17.

17. **Drègei,** Otto & Dietr. (*B. cáffra,* Meisn. *B. parvifòlia,* Grah. *B. renifórmis,* Hort.). Glabrous: sts. succulent, annual, 1–3 ft. high: from a rootstalk a fleshy irregular tuber: lvs. thin, small, oblique-ovate, green, deeply serrated, reddish on the under side: fls. white, small, profuse. Cape of Good Hope. B.M. 3720. —Received at Botanic Gardens, Edinburgh in 1836 from Berlin. A useful free-flowering greenhouse plant.

18. **weltoniénsis,** Hort. (*B. Sútherlandii* × *B. Drégei*). St. reddish, 1–3 ft. high: lvs. light green, smooth, ovate-acuminate, lobed, dentate, 1½–2 in. across; petiole red, 1–1½ in. long: fls. pink, profuse, on short peduncles.—Frequently met with in cottagers' windows in England; of very easy cult. Intro. by Major Clark, of Welton Park, England. Var. **álba,** Hort., has white fls.

19. **fúlgens,** Lemoine. Stout: st. short: lvs. large-reniform to cordate-ovate, more or less oblique, irregularly sinuate-toothed, sparsely hairy above and beneath, dull dark green above and reddish on the under side:

fls. large (2 in. across) in many long-peduncled clusters, bright rich rose-red, fragrant. Bolivia.—A handsome plant, published by Lemoine in catalogue of 1893.

BBB. *Lvs. orbicular.*

20. **Baûmannii,** Lemoine. Loose-hairy or nearly glabrous, the sts. often very short and the plant appearing acaulescent, but becoming 1–1½ ft. high: lvs. large, orbicular, with short, thick petioles: peduncles 18 in. high, bearing panicles of 4–6 fls., which are rose-red, 4-petaled, from 3–4 in. across, and fragrant as roses. Bolivia, 8,000–9,000 ft. B.M. 7540. Gt. 40:1348; 42, p. 25. A.F. 7:561. G.F. 5:77.—It is described as plentiful in the moist valleys of the Cordilleras, where it is eaten by cattle. Distributed by Lemoine in 1890. Tubers as large as ostrich eggs. Habit of *B. socotrana.*

BBBB. *Lvs. various, mostly broad-ovate at base, acuminate, oblique.*

21. **tuberhýbrida,** Voss (*B. tuberòsa,* Hort.). Figs. 510, 511, 512. The garden race of tuberous begonias, combined of many species and derived from many sources, very variable and yet for the most part agreeing in general lf. form. There are many named garden varieties.

512. Begonia tuberhybrida. Double-flowered form. No. 21.

OTHER TUBEROUS-ROOTED SPECIES.

22. **cinnabarìna,** Hook. Puberulent: sts. short, green, zigzag, slightly downy: lvs. on short petioles, obliquely ovate, lobed and serrated: peduncles 9–12 in. long, red; fls. cinnabar-red, 2 in. across. Bolivia. B.M. 4483. P.M. 16:225.—Intro. 1849; not in cult.

23. **crinìta,** Oliver. Slender, sparsely hairy: sts. red, hairy, 1 ft. high: lvs. ovate-cordate, irregularly toothed, tinged with red on the under side: peduncles erect, red, producing 3 pale rose-colored fls. Bolivia. B.M. 5897.—Intro. by Veitch in 1866.

24. **cyclophýlla,** Hook. Slightly hairy, slender, stemless: lf. solitary, orbicular, 6 in. across, green, with fimbriated margin: peduncles erect, 6 in. long; fls. rose-colored, with the fragrance of roses. China. B.M. 6926.—Intro. to Kew in 1885.

25. **geranifôlia,** Hook. Glabrous: st. 1 ft. high, erect, greenish: lvs. cordate, lobed, incised and serrated, green, margins red: fls. 2 or 3 on terminal peduncles, outer petals orbicular, red; the two inner obovate, white. Lima. B.M. 3387.—Intro. 1833.

26. **geranioìdes,** Hook. Small, 10–14 in., stemless, rootstock fleshy: lvs. radical, reniform, 6 in. across, lobed and toothed, green, hairy, petioles 8 in. long: peduncles erect, 6–12 in. long, reddish, hairy, bearing a lax panicle of fls., each 1¼ in. across, pure white, with a button-like cluster of yellow anthers. Natal. B.M 5583.—Planted in a border in a sunny greenhouse, this is a fine begonia, flowering profusely during Oct. and Nov. Intro. to Kew in 1866. Probably not now in cult. Allied to *B. Dregei.*

511. Begonia tuberhybrida. Double-flowered. No. 21.

27. **natalénsis,** Hook. Glabrous: sts. fleshy, 1–2 ft. high: lvs. obliquely cordate, lobed, sinuate, 2–3 in. long, green, sometimes mottled with gray, veins reddish: fls. yellowish white, tinged with rose, 1 in. across. Natal. B.M. 4841.—Intro. to Kew in 1854.

28. **polypétala,** A. DC. St. short, fleshy: lvs. ovate-cordate, toothed, hairy, with raised veins, 10x8 in.: fls. with 9 or 10 ovate-oblong petals an inch long, red; ovary hairy, with 1 long wing. Peru. Gn. 14, p. 531.—Intro. by Froebel in 1878.

29. **rubricaûlis,** Hook. Pubescent, stemless, scapes red: lvs. 4–6 in. long, ovate, wavy, ciliate along the margins, deep green: fls. large, males 1¼ in. across, 5-petaled; females smaller, 6-petaled, reddish. Country unknown. B.M. 4131.—Intro. to Birmingham Botanic Garden in or about 1844.

30. **ténera,** Dry. (*B. Thwàitesii,* Hook.). Pubescent, stemless: lvs. radical, cordate, 5 in. long, coppery green, mixed with purple and blotched with gray, under surface very red: fls. white, tinged pink. Ceylon. B.M. 4692.—Chiefly interesting as a variegated plant. Intro. to Kew about 1852.

III. SPECIES RHIZOMATOUS: *the rhizomes mostly shaggy and lying on top the ground or very nearly so (Fig. 516); plant making no proper upright stem or trunk. Nos. 31–59.*

A. *Plant creeping, trailing, or climbing.*

31. **glaucophýlla,** Hook. (*B. glaucophýlla spléndens,* Hort. *B. glaucophýlla scándens,* Hort. *B. Comte de Limminghe,* Hort. *B. Limminghei,* Hort.). Glabrous: sts. long, drooping or creeping, lending themselves to training on rafters: lvs. ovate, wavy, 3 in. long, glaucous green, reddish and variegated in bud, purple beneath and white-spotted above, the margin cartilaginous: fls. brick-red, males 1 in. across, with petals, females of equal petals. Brazil. B.M. 7219. Gn. 59, p. 336.—A good basket plant, flowering freely all winter. Excellent for a permanent position in a greenhouse; reaches 6–8 ft. or more high.

32. **scándens,** Swartz (*B. lùcida,* Otto & Dietr. *B. ellíptica,* HBK.). Glabrous: sts. climbing or trailing, clinging by means of short aërial roots: lvs. ovate or broader, acuminate, notched at base, dentate, glossy green, 4 in. long: fls. small, white, hanging in ball-like clusters. W. Indies and S.—An excellent basket or climbing plant.

AA. *Plant upright, often diffuse.*

B. *The picture-lvd. set: plants low and tending to be compact, the mature lvs. usually hanging nearly vertical, often variously colored and marked.*

C *Lvs. oblique, lobed at the base, not peltate (or only slightly so).*

33. **Rex,** Putz. Fig. 513. Very hairy: st. a short, fleshy rhizome, from which spring the long-stalked large ovate wavy lvs., which are hairy and colored a rich metallic green, with a zone of silvery gray: peduncles erect; fls. large, rose-tinted; males 2 in. across, with 4 unequal petals; females smaller, with 5 nearly equal

513. Begonia Rex, in its original form. No. 33.

petals; ovary 3-angled, with 2 short and 1 long wing. Assam. F.S. 12:1255–1258. B.M. 5101.—This noble species is the principal parent in the production of the numerous ornamental-foliaged begonias. It has been crossed with a few species in the first place, and then hybrid seedlings have been raised again and again from the progeny. Fig. 513 is a copy of a part of the original figure in Flore des Serres (1857), and is given here for the purpose of showing what this species was like when first known to horticulturists. There are very many named forms, but most of the listed kinds tend soon to pass out. One of them that has persisted, because of the odd quirl to the lf. is *Countess Louise Erdoedy* (B. Alexander von Humboldt × *B. argentea-cupreata*). Fig. 514. Lvs. obliquely cordate, ovate-acute, the smaller of the 2 lobes twisted in a spiral manner, with as many as 4 coils; upper surface silvery, with veins deep green; under surface reddish, pilose. I.H. 31:516. G.C. II. 22:205. Intro. by F. Nemeczek, gardener to Count Erdödy, a Hungarian nobleman, in 1884.—Other Rex varieties of unknown or uncertain origin: *Louise Closson.* Lvs. ovate-acuminate, lobed, veins deep purple, surface blotched with deep purple bronze, metallic luster very bright. *Lucy Closson* is very similar, but more vigorous, with the blotches more numerous and better distributed. *Marquis de Peralta.* Lvs. small, margins hairy, numerous silvery spots on surface. Compact, dense grower. *Duchesse de Brabant.* Lvs. large, purple, margins and surface hairy, otherwise like *B. Rex. Louise Chretien.* Lvs. green, with a zone of glossy silver towards the center, covered with very small white spots. *Count Erdoedy.* Silver-white, green-striped along the veins, hairy; lobes twisted into a spiral, hairy.

34. **xanthìna,** Hook. Similar to *B. Rex:* lvs. large, fleshy, cordate-ovate, acuminate, sinuate-ciliated, dark glossy green above, purplish beneath: fls. large, almost golden yellow, tinged on the back with red: caps. with one large wing. India. B.M. 4683. Var. **pictifòlia,** Hook. Lvs. with rows and spots of silvery white: fls. yellowish white. B.M. 5102. Var. **Lázulii,** Hook. Lvs. not spotted, tinted with bluish purple. B.M. 5107. This species is probably not now in cult.

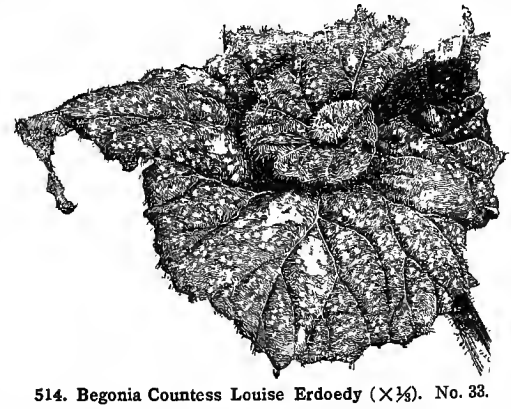
35. **Griffithii,** Hook. (*B. pícta,* Hort.). St.-lvs. and habit as in *B. Rex:* lvs. olive-green, with a broad zone of gray inside a purple margin, tinged with red on the under side, the basal lobes overlapping: fls. large, fleshy, pink; ovary curiously crinkled along the angles. Assam. B.M. 4984.—Intro. by Henderson, England, in 1856. Probably not now in cult.

36. **Rājah,** Ridley. Fig. 515. Lvs. from the rootstock, angular-orbicular, papery, the petioles and under veins setose, upper surface smooth and richly mottled from the green ribs and the brown or brown-red intermediate spaces, the margins serrate and setose: fls. small, pink, on hispid peduncles that stand about as high as the lvs. Malaya. G.C. III. 16:213. —A distinct and beautiful hothouse species, deserving of popularity. Said erroneously to be a garden hybrid.

37. **Augústinei,** Hemsl. A dwarf, compact species, allied to *B. Rex* but devoid of color in the lvs. as in that species: sts. branching freely, short-jointed: lvs. erect or spreading, elliptic or ovate, 3–6 in. long, reddish green above and below, covered on both sides with red hairs; petiole red, terete, provided with dense white hispid hairs: whole plant presenting a mixture of white or red hairs: infl. erect, few-fld.; fls. pink. China.—Differs from *B. xanthina* in its rough rugose hairy lvs. and rose-pink fls.

38. **dædálea,** Lem. (*B. strigillòsa,* Dietr.). Hairy, Rex-like: st. a short, thick rootstock: lvs. large, green, ovate-acuminate, cordate, margins slightly serrate and beset with long reddish hairs, surface covered with a peculiar network of russet-brown: peduncles spotted and slightly hairy; fls. white, tinged with pink. Mex. I.H. 8:269.—A handsome foliage plant, not very widely known.

39. **speculâta,** Hort. Probably a hybrid: st. a short, thick rhizome: lvs. broadly ovate, acuminate, cordate, lobed half way down the blade, on long, hairy petioles, dull green, rough, speckled with gray, hairy, reddish on the under side, veins very prominent, light green: fls. on long, hairy peduncles, pink-white, males and females both with 2 petals: caps. green, with small red



514. Begonia Countess Louise Erdoedy (×⅓). No. 33.

spots.—Origin uncertain, although apparently common in cult. in this country. A hardy and useful begonia for conservatory and window-garden.

40. **decòra,** Stapf. A small species of compact habit, allied to *B. Rex:* rhizome short, reddish green: lvs. 3–4 in. long, ovate, rich reddish brown with prominent yellow-green veins: whole plant covered with thick-set papillæ and short hairs: fls. pink, comparatively large for so small a plant. Perak.—This plant thrives best in a stove. It is readily crossed with many other species, notably with *B. Rex,* and the offspring are amongst the finest ornamental foliage plants.

41. **imperiàlis,** Lem. Very hairy, low: st. short, herbaceous, green: lvs. 4–6 in. wide, brownish green, with irregular bands of bright green along the nerves, making a striking contrast: fls. insignificant, white. Mex. I.H. 8:274. Var. **maculàta,** Hort., has brown lvs. with green blotches. Var. **smarágdina,** Hort., has wholly bright green lvs. I.H. 7:262.—These plants require a hothouse treatment in winter.

CC. *Lvs. markedly peltate.*

42. **módica,** Stapf. A spreading, dwarf plant with sts. green, slender: lvs. peltate, orbicular or broadly ovate, 2–4 in. long, pale green in color, margins pink, undulate, margins and veins ciliate; petioles greenish red, hairy, 3–5 in. long: infl. few-fld., males small, 2-petaled, orange-yellow, with red blotch at base of petals, females same as males in color; ovary 4-celled, ½in. long, winged, hairy. W. Trop. Afr. B.M. 8258.—A recent species, requiring stove conditions.

43. **Géntilii,** De Wild. A near ally of *B. modica:* sts. creeping, red hairy: lvs. peltate, erect, ovate, acute, margins finely serrate, slightly reflexed, green suffused with light red, young lvs. red; petiole terete, red, hairy, 6–12 in. long; blades 3–4 in. long: infl. few-fld.; fls. orange-yellow suffused with red; ovary 4-celled, winged. Congo.

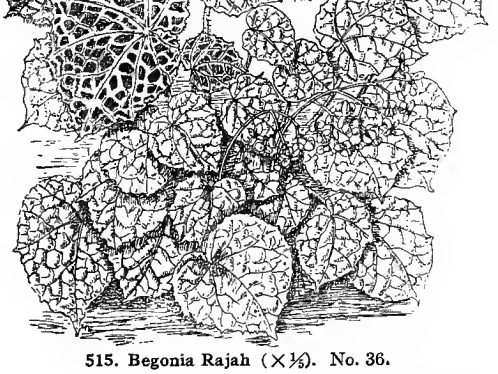
44. **Binòtii,** Hort. Plant rough-hairy like *B. Rex:* lvs. elliptic-orbicular, markedly peltate, green above and red-hairy beneath, blistered or bullate.—Very recently offered, and yet little known.

45. **goegoénsis,** N. E. Br. FIRE KING. Compact but large plant: st. a short, thick, greenish red rootstock: lvs. handsome, erect, peltate, ovate-orbicular, 6–9 in. long, surface blistered or puckered green, with dark bronzy blotches, prominently veined, dull red on the under side: fls. small, rose-pink, in a lax cluster 6 in. high. Goego, Sumatra.—A distinct and ornamental-lvd. plant, requiring stove conditions; deserves the attention of amateurs.

BB. *The essentially plain-lvd. rhizomatous kinds, although some of them are grown almost wholly for the foliage. (Some of this group are bold and striking.)*

C. *Lvs. prominently lobed, or parted or even divided.*

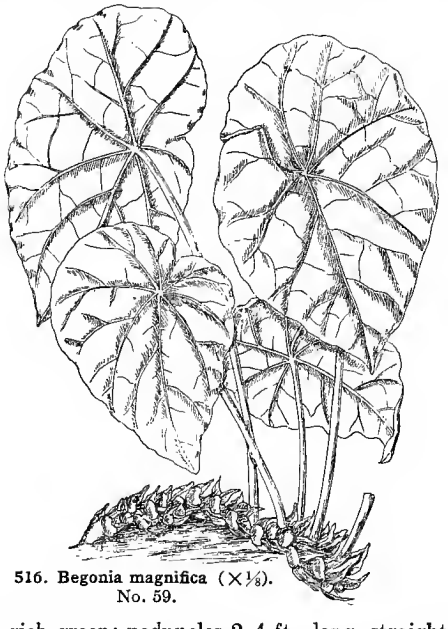
46. **ricinifòlia,** Hort. (*B. heracleifòlia* × *B. peponifòlia*). St. a short, thick rootstock: lvs. large, bronzy



515. Begonia Rajah (×⅓). No. 36.

green, lobed, resembling castor-oil plant: fls. numerous, on long, erect peduncles, rose-pink.—A useful free-flowering plant for the greenhouse, producing its fls in winter and early spring. Var. **gigantèa odoràta,** Hort., is a double hybrid (*B. ricinifòlia* and *B. fùlgens* × *B. Scharffiàna*) of German origin. Lvs. large, round-cordate, the lobes extending one-third or less deep and notched: fls. on long scapes, standing above the lvs., delicate rose-color and with tea-rose odor. Gt. 54, p. 42.

47. **heracleifòlia,** Cham. & Schlecht. (*B. jatrophæfòlia,* Hort.). Hairy: st. a short, thick rhizome: lvs. 6–12 in. across, with 5–9 deep and narrow notched and toothed



516. Begonia magnifica (×⅛). No. 59.

lobes, rich green: peduncles 2–4 ft., long, straight: fls. white or rose-tinted, small, with 2 prominent rounded parts. Mex. B.M. 3444. B.R. 1668. J.H. III. 56:309. Var. **nìgricans,** Hook., has the margins of the lvs. bordered with dark (almost black) green. B.M. 4983. Var. **longípila,** Hort. has long, fleshy hairs on the lf.-stalks and peduncles. **B. Súnderbruchii,** Hort., is an American form of this var.: lvs. bronze-green, silver bands along the nerves, purple underneath. Var. **punctàta,** Hort., has green lvs., reddish near the margin: fls. rose-colored, with deep red spots on the outside.

48. **rubélla,** Hamil. Smooth: st. a short, thick rhizome: lvs. handsome, large, cordate, acuminate, deeply lobed, spotted with irregularly shaped dark brown marks: fls. pale pink, on long peduncles, decorative. Nepal.

49. **Verschaffeltiàna,** Regel (*B. Verschaffèltii,* Hort. *B. manicàta* × *B. caroliniæfòlia*). Hairy: st. a thick rhizome: lvs. large, ovate, acuminate, lobed: fls. rose-colored, pendent on long peduncles. I.H. 2:68.—Tall, coarse and unsightly as an old specimen, but when well grown from year to year from cuttings makes an excellent plant and produces quantities of its small rose-colored fls. in early spring, which last for several months and have a considerable decorative value.

50. **heracleicótyle,** Veitch (*B. heracleifòlia* × *B. hydrocotylifòlia*). A small, essentially smooth plant, with lvs. close to the rhizomes: lvs. thick, obliquely cordate-ovate, many-lobed and toothed, margins slightly ciliate, shining metallic green above and reddish beneath: fls. pink, small, freely produced on about 8 free-branching peduncles in early spring. Veitch, 1895.—A useful and decorative greenhouse plant.

CC. *Lvs. lanceolate to ovate or cordate-ovate to orbicular, not deeply lobed, often entire, and sometimes peltate.*

D. *Foliage small, the lvs. less than 2 in. wide.*

51. **hydrocotylifòlia,** Otto. Whole plant hairy: st. succulent, creeping: lvs. rotundate-cordate, repand but

entire, small, on short petioles and therefore clustered near the ground: peduncles 1–1½ ft. high, pilose; fls. dipetalous, rose-colored, small and numerous, showy. Mex. B.M. 3968.

DD. *Foliage of usual or large size.*

E. *The lvs. peltate.*

52. **Fèastii,** Hort. (*B. manicàta* × *B. hydrocotylifòlia*). Shaggy-hairy on petioles and lf.-edges: st. a short, thick rootstock: lvs. suborbicular, thick, red beneath,

517. Begonia semperflorens. A recently struck cutting. To show the precocity of bloom. No. 60.

entire with long white hairs on margins; petioles short, irregularly marked: fls. light pink, on long peduncles. A.G. 23:335.—Intro. by John Feast, of Baltimore, before 1880. A common pot and house plant. **B. Búnchii,** Hort., is a form with edges of lvs. crested and frilled. Originated with Lloyd C. Bunch, Fredonia, Kan.

53. **nelumbiifòlia,** Cham. & Schlecht. Hairy: st. a short, thick rhizome: lvs. large, 12–18 in. long, 8–12 in. wide, peltate, hairy on the under side, on long upstanding petioles: fls. many and small, white or rose-colored, in a dense erect much-branched cluster. Mex.—The foliage is bold and handsome, and distinct in general effect from any other cult. species.

54. **conchæfòlia,** A. Dietr. Lvs. nearly peltate or semi-peltate, thick, cordate-ovate and the basal lobes or ears overlapping, margins entire or repand, becoming smooth above, shining green above and reddish beneath: fls. pink. Cent. Amer.

55. **Lúbbersii,** E. Morr. Semi-shrubby, the short rhizome occasionally ascending and becoming gouty at the base: lvs. large, peltate, obliquely lanceolate, entire, green with many silvery blotches above, claret-colored beneath: fls. white, on long peduncles. Brazil. G.C. III. 3:301. R.H. 1888, p. 225.—Named in compliment to M. Lubbers, curator Brussels Bot. Gard. Has spots like *B. maculata.*—Of little horticultural value.

56. **álbo-coccínea,** Hook. (*B. Grahamiàna,* Wight). Smooth and shining: rootstock creeping: lvs. peltate, ovate, leathery, 6 in. long: peduncles 1 ft. long, coral-red, springing from the crown; male fls. 1 in. across, with 4 petals; female fls. also of 4 petals, white above, coral-red beneath. Flowers in winter. India. B.R. 32:39. B.M. 4172.—A beautiful species, apparently little cult. now.

EE. *The lvs. not peltate.*

57. **manicàta,** Cels. Essentially smooth except the hairy lf.-edges, short-stemmed, succulent: lvs. ovate, obliquely cordate, thick, fleshy, smooth, shiny green, 6–8 in. long; petioles covered with fleshy scale-like hairs: peduncles a foot or more long, bearing loose panicles of pink dipetalous fls. Mex. Var. **aùreo-maculàta,** Hort., has large blotches of yellowish white on the lvs. F.E. 8:1159. F.R. 2:435. A.G. 23:337.—Flowers profusely in spring, having a light elegant and feathery effect supported on long erect and free-branching peduncles. Var. **crìspa,** Hort., has foliage with crispate margins; there is also a yellow-spotted form of it.

58. **lepròsa,** Hance. A dwarf, compact species, with short, free-branching rhizomes and erect, ovate, pale green lvs. with biserrate margins and reaching to a height of 6–9 in.: infl. few-fld.; fls. large for so small a plant, rose-pink, male with 4 petals and female with 6 petals: partially deciduous during the winter months. China.—Thrives best in a greenhouse.

59. **magnífica,** Lind. Fig. 516. Sub-frutescent, smooth and shining, the sts. creeping: lvs. large and bold, sometimes rising 2 ft., obliquely ovate-cordate, entire or obscurely lobed, serrate, slightly peltate, bright green, the margins ciliate: fls. long and fuchsia-like, numerous, the sts., bracts, fls. and hairs of the clusters all scarlet-red, showy. Colombia. R.H. 1870: 270.—One of the best of the rhizomatous begonias. Lf.-blades often 2 ft. across.

IV. Species Fibrous-rooted (*rootstock, if any, small*). Nos. 60–119.

A. *The small succulent herbaceous kinds, never becoming very tall or woody.*

60. **semperflòrens,** Link. & Otto (*B. Séllowii,* Klotzsch). Fig. 517. Erect, smooth plants with st. herbaceous, green or reddish, 6–18 in. high: lvs. ovate, rotundate, obtuse at the base, toothed and ciliate along the margin, pale glossy green, tinged with red on the midrib and petiole: peduncles axillary, few-fld.; fls. white or rose-colored; males with 4 petals, females with 5 petals: caps. green, wings tinged with red. Brazil. L.B.C. 15:1439. R.H. 1897, p. 46. B.M. 2920. —This is an exceedingly variable species. An endless number of garden forms has been produced from it. A very popular bedding begonia, and a persistent bloomer. Var. **Vernon** (*atropurpùrea compácta,* Gt. 44, p. 570) is one of the best forms. **Triomphe de Lorraine** (Fig. 518) is one of the good bedding kinds. Fls. cherry-red, the stamens golden yellow. **Gloire de Châtelaine** is a form of dwarf habit and deep rose fls.; one of the best in England for bedding and pots, and a continuous bloomer.

518. Begonia, Triomphe de Lorraine (×⅓). No. 60.

61. Var. **gigantèa ròsea** (*B. semperflòrens* × *B. Lyncheàna*). Very distinct: rootstock woody: sts. succulent, about 3 ft. high: lvs. on short petioles, ovate or reniform, obtuse, toothed at

XIV. Foliage begonias well grown in banks, with ferns and similar plants.

the margins, about 7 in. across, bright green, with a red spot at base of sinus: peduncles axillary stout, 4–8 in. long, bearing large panicles of large rosy red fls., of which the males have 2 ovate petals, the females 2–4 smaller petals. A.F. 13:586. A.G. 16:41. —One of the best begonias for winter decoration in the cool greenhouse. Intro. by Lemoine in 1888.

62. **Carriérei,** Hort. (*B. semperflòrens* × *B. Schmidtii. B. Bruántii,* Hort. *B. Smithii,* Hort.). Dewdrop. Compact, about 1 ft. high: lvs. like *B. semperflorens:* fls. nearly as large as in *B. semperflorens,* abundant, pure white. G. 6:557. J.H. III. 53:249.—Excellent bedding begonia; also a good late winter bloomer. Intro. by Bruant in 1883.

63. **Érfordii,** Hort. (*B. Schmidtii* × *B. semperflòrens Vernon*). Very dwarf and bushy, 1½ ft. high: fls. abundant, rose-carmine.—Excellent for bedding. Intro. by Haage & Schmidt in 1894.

519. Begonia Corbeille de Feu ("Basket of Fire") (×⅓). No. 66.

64. **Luncheàna,** Hook. (*B. Roèzlii,* Hort., not Regel). Glabrous: rootstock stout, somewhat tuberous: st. erect, tall, succulent, smooth: lvs. green, smooth, ovate-cordate: sinus red: fls. in axillary, drooping cymes, deep reddish crimson. Mex. B.M. 6758.—Very like *B. semperflorens gigantea rosea,* but not so strong a grower. Perhaps not now in cult.

65. **Luciànæ,** Hort. (*B. Lyncheàna*×*B. Bruántii*). Fls. large, in the axils of the lvs., rose.—Intro. by Bruant in 1889.

66. **Corbeille de Feu** (*B. semperflòrens*×*B. fuchsioìdes*). Fig. 519. Intermediate in habit between its parents: fls. bright coral-red, produced in quantity nearly all the year round.—The plant branches freely from the base and makes an excellent bedding plant; the fls. are rich-colored and withstand the sun well. Intro. by Lemoine, 1891.

AA. *The kinds becoming woody or shrubby, mostly tall and much branched.*

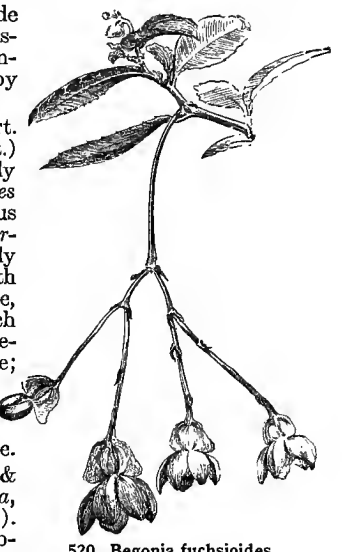
B. *Plants slender, upright, small-leaved.*

C. *Fls. pink or red.*

67. **fuchsioìdes,** Hook. Fig. 520. Smooth: rootstock woody, not prominent: sts. slender and erect, 2–3 ft., succulent: lvs. many and small, ovate, 1½ in. long, tinged with red when young: fls. drooping like a fuchsia, rich scarlet, males with 4 petals, females with 5 petals. Mex.—Requires the conditions of a warm airy greenhouse. If kept in a moist close atmosphere it is apt to damp off badly, and if kept too warm it makes a lot of growth and produces very few fls. It rapidly forms a large specimen if kept growing, and is a most attractive plant for greenhouse decoration during winter and spring months. B.M. 4281. Var. **miniàta,** Lind. (*B. cinnabarìna,* Hort.), differs only in having flesh-colored fls. and smaller lvs. R.H. 1855:221. F.S. 8:787.

68. **Íngramii,** Hort. (*B. nítida* × *B. fuchsioìdes*). Fig. 521. Combines the characters of the two species: very free-flowering and makes a most desirable bedding plant, and also blooms well in winter: fls. rose, large: foliage tinted with red when exposed to the sun. The horizontal blooming side branches are characteristic of this plant as a greenhouse subject.—Intro. by Ingram in 1849.

69. **Digswelliàna,** Hort. (*B. Sándersonii,* Hort.) A useful hybrid probably between *B. fuchsioìdes* and one of the numerous varieties of *B. semperflorens:* sts. erect or nearly so, green suffused with red: lvs. elliptic, serrate, 2–4 in. long, dark rich green in color: infl. medium in length and size; fls. rosy scarlet, pendulous.—A useful bedding plant or may be used for a cool greenhouse.



520. Begonia fuchsioides (×¾). No. 67.

70. **incarnàta,** Link & Otto (*B. aucubæfòlia,* Hort. *B. insígnis,* Grah.). Smooth: st. erect, subherbaceous, 2–3 ft. high: lvs. very unequally cordate, ovate-lanceolate, toothed: fls. rose-colored, abundant, males 1½ in. across, with 2 ovate and 2 narrow petals; females smaller, with 5 equal petals. B.M. 2900. A.G. 16:97. A.F. 12:724–5; 13:588; 17:857. R.H. 1870, p. 266; 1875:151. Var. **grandiflòra,** Hort., is a much improved variety, very useful for cut-fls. or decoration in winter.

71. **ascotiénsis,** Weber. Of hybrid origin, probably obtained from *B. fuchsioides* and one of the forms of *B. semperflorens:* lvs. ovate, 2 in. long, smooth, brown, margin green, dentate: fls. on peduncles 4 in. long, bright red.—An excellent bedding begonia.

CC. *Fls. white, or tinted white.*

72. **foliòsa,** HBK. Small, smooth, shrubby: sts. herbaceous, slender, branching: lvs. very many, frond-like, very small, somewhat 3-lobed, glossy green, distichous: fls. white, tinged with rose. Blooms early summer. Colombia.—An elegant little basket and ornamental plant.

73. **knowsleyàna,** Hort. Much like *B. incarnata,* but lf. smaller, entire or nearly so: fls. nearly white. Named for Knowsley, seat of the Earl of Derby. Origin not known; probably a seedling of *B. acuminata.* A good winter bloomer, particularly in 6-in. pots. J.H. III. 49, p. 177.

521. Begonia Ingramii (×⅓). No. 68.

74. **acuminàta,** Dry. Slender, 3–4 ft.: sts. nearly or quite smooth: lvs. 2–3 in. long, oblique-ovate, tapering to the point, toothed and serrate, the margin and veins underneath hairy: fls. white, 3–5 on a peduncle, nearly 1 in. across, spring and summer. Jamaica.—A

useful plant for growing in baskets, thriving and flowering freely in a sunny position in a cool airy greenhouse. Intro. to Kew in 1790. B.M. 4025. B.R. 364.

75. álbo-pícta, Hort. Shrubby, compact growth, freely branched: lvs. elliptical, lanceolate, covered with

522. Begonia Scharffiana. No. 89.

numerous small silvery white spots: fls. greenish white, males with 2 broad and 2 narrow petals, females of 5 subequal petals. Brazil.—An elegant foliage plant, especially in the young state. Intro. by Bull in 1885.

BB. *Plants low-growing, diffuse.*

76. **Schmidtiàna,** Regel (*B. Schmídtii,* Hort.). Herbaceous or half-shrubby, slender-branched, 1 ft. or less in height, the branches red-tinged: lvs. lobed, toothed, hairy, about 2 in. long, reddish beneath: fls. white, tinted with rose. Brazil. R.H. 1883, pp. 56–7. Gn. 17, pp. 268–9.—A very useful plant for summer bedding. Named for Mr. Schmidt, of the firm of Haage & Schmidt, Erfurt. Var. **ròsea,** Hort., has rose-red fls.

BBB. *Plants stiff, succulent, white-scurfy.*

77. **peltàta,** Hassk. (*B. Hásskarlii,* Zoll.). Upright: st. perennial: lvs. peltate, ovate-acuminate, very thick and succulent, covered with a whitish tomentum, 6–9 in. long: fls. small, white, on long peduncles. Brazil.—It is the only begonia in cult. with thick, felted, peltate, silvery lvs.

78. **venòsa,** Skan. A tall, stout, erect species with white-frosted very fleshy foliage, and marked by very large inflated conspicuously veined stipules: lvs. reniform or ear-shaped, repand-entire, joined at the middle (not peltate) with the thick flattened petiole: fls. many, white, crowded on a reddish peduncle. Brazil. B.M. 7657.—Very distinct, and a striking plant when well grown. Requires a warm sunny position in the greenhouse, and to be kept rather on the dry side at the roots during winter.

BBBB. *Plants mostly tall and erect, distinctly shrubby.*

C. *Lvs. compound or nearly so.*

79. **luxùrians,** Scheidw. Sts. and lf.-stalks hairy, the lf.-stalks reddish: pointed membraneous stipules at the younger nodes: lvs. peltately compound, the 7–17 lfts. lanceolate (3–6 in. long and 1 in. broad), serrate, under surface glabrous and green, upper surface with stiff short hairs and red: fls. small, cream-color, in a compound long-stalked cluster. S. Amer. G.C. III. 51:28.—Thrives in an intermediate temp.

80. **Hemsleyàna,** Hook. Slightly hairy: habit dense, free-branching: sts. erect, red, hairy: lvs. digitate 6–12-parted, the parts or lfts. lanceolate or elliptic, slightly curved, serrate undulate, rich shining green above, dull greenish red beneath; petiole long, red: sts. and petioles covered with soft-tomentose hairs: infl. slender, few-fld.; fls. pink, large, 1–1½ in. diam. Yunnan, S. China. B.M. 7685.—One of the hardiest species.

81. **platanifòlia,** Hort. (Schott?). St. shrubby, smooth, 5–6 ft. high, erect, robust, smooth, green, joints annulated: lvs. 8–10 in. across, reniform, lobed half way down, hispid on both sides, dark green, lobes acute, toothed, ciliated: fls. in axillary dichotomous cymes, large, white, tinted rose. Brazil. B.M. 3591.—**B. gunneræfòlia,** Lind. (*B. Washingtoniàna,* Hort.), is very similar to this, but its lvs. are not so deeply lobed and the fls. are very insignificant. I.H. 22:212. Runs into many forms. See *B. Faureana* in supplementary list, p. 484.

82. **digitàta,** Raddi (*B. palmàta,* Hort.). St. short, gouty: lvs. palmate, 10–12-parted, somewhat pubescent, green above, brownish beneath: fls. white, in dense clusters. Brazil.—A species of little decorative value.

83. **caroliniæfòlia,** Regel. St. erect, thick, fleshy: lvs. palmately divided into 6–8 long ovate segms.: fls. small, pink, on long peduncles. Mex. Gt. 1:258.—Named for its lvs. resembling those of the Carolinea (Pachira). The lfts. are ovate, rather than narrow as in most begonias with divided or compound lvs., and in this regard peculiar.

84. **diadèma,** Lind. Sts. short and fleshy, 2 ft. high: lvs. many, maple-like, deeply parted, bright green blotched with white, dentate: fls. insignificant, pink. Borneo. I.H. 29:446.—Attractive for its conspicuously marked foliage.

CC. *Lvs. not compound.*

D. *Whole plant hairy.*

E. *Foliage light green, and plant pubescent.*

85. **vitifòlia,** Schott, not Lindl. (*B. grándis,* Otto. *B. reniformis,* Hook.). Tall, strong species, 3–4 ft. high: lvs. large and grape-like (*Vitis vinifera*), orbicular or reniform, lobed and serrate, soft-pubescent, green above and rusty veined beneath, the petiole flat or canaliculate on top: fls. small, white, slightly downy, winter. Brazil. B.M. 3225.

523. Begonia Haageana. Showing a very small cluster (×½). No. 91.

86. **Éngleri,** Gilg. (*B. Englerìana,* Hort.). Striking species with mostly a single st.: conspicuously red-strigose-hairy and scaly, becoming 5 ft. tall: lvs. large and showy, thin, oblique and ovate-oblong, deeply and evenly serrate, hairy, red-ribbed: fls. on long pendulous peduncles, numerous, pink. E. Trop. Afr.—Distinct, and worthy of attention on account of its handsome hairy lvs.

EE. *Foliage colored above or beneath, or both.*

F. *Fls. white.*

87. **echinosèpala,** Regel. St. green, succulent, erect and branching freely: lvs. obliquely oblong, finely serrate, rather small: fls. on axillary peduncles, white, with curiously papillose sepals. Brazil.—A useful species for warm greenhouse, of very easy cult. and very free-flowering. One of the best for decoration.

524. Begonia cathayana (×⅙) No. 95.

88. **erythrophýlla,** Neum. Soft-hairy, the st. fleshy, strong: lvs. thick, reniform, long-stalked, dark green and lustrous above and red beneath, almost entire, strigillose: fls. small, white.—Probably of garden origin.

89. **Scharffiàna,** Regel. Fig. 522. A robust herbaceous perennial, 1–3 ft. high: lvs. large, thick, fleshy, hairy, olive-green above, crimson below: stipules very large and prominent: fls. waxy white with red hairs on under surface of petals, large. Brazil. Gt. 1888, p. 661. —This begonia requires warmth and care to succeed well. When well grown, it is an excellent bracket-plant.

90. **Duchârtrei,** Hort. (*B. echinosèpala* × *B. Scharffiàna*). St. 2–3 ft. high, branched profusely, hairy, purple: lvs. ovate-lanceolate, acuminate, green above, hairy, red below: fls. large, waxy white, a few red hairs on the under surface of petals. R.H. 1892, p. 29.—Intro. by Bruant in 1892.

FF. *Fls. colored.*

91. **Haageàna,** Wats. (*B. Schárffi,* Hook.). Fig. 523. Tall-shrubby, whole plant hairy: lvs. ovate-cordate, acuminate, wavy, red-nerved above: fls. rose-pink, with a cyme 8–12 in. diam., males with 2 round and 2 narrow petals, females with 5 equal petals. Brazil. G.C. III. 16:633. B.M. 7028, (as *B. Scharffi*).—One of the most beautiful plants of the genus, and now one of the best known of the big tall red-hairy begonias; the hanging trusses of fls. (imperfectly represented in Fig. 523) are very conspicuous. Named for one of the firm of Haage & Schmidt. *B. Crédneri,* Hort. (*B. Scharffiàna* × *B. metállica*). Intro. by Haage & Schmidt, 1890. There is another plant named *B. Credneri,* which was raised by Lemoine in 1891 from the same parents. Bruant also used these two parents in 1891, and called his plant *B. pictaviensis.* All three plants can be distinguished from *B. Haageana* only by their smaller fls. and the peduncles standing erect and not gracefully bending over, as in *B. Haageana.*

92. **Alléryi,** Hort. (*B. metállica* × *B. gigantèa*). Of the *B. Haageana* type: hairy, lvs. bronzy, red-veined beneath, toothed: plant becoming very tall (even 4–6 ft. in a single year), producing many large pendulous clusters of rose-colored fls.—A very fine warm greenhouse or stove variety, free-flowering, of easy cult. Shown in 1905 before Société National d'Horticulture de France by M. Allery Aubert of Tours.

93. **metállica,** G. Smith. Hairy: sts. perennial, succulent, 4 ft. high, branched: lvs. obliquely cordate, lobed and serrated, 3–6 in. long, upper surface green, shaded with a dark metallic color: fls. blush-white, under side of petals clothed with red bristly hairs. There are a number of varieties, e. g., var **variegàta,** var. **velùtina,** var. **cýprea,** but they do not differ much from the original. Bahia. R.H. 1844:218 (as *B. velutina*). G.C. II. 5:397.—A very attractive plant.

94. **Margarîtæ,** Hort. (*B. metállica* × *B. echinosépala*). Plant 1–2 ft. high: sts. purple, hairy: lvs. ovate-acuminate, sinuously dentate, green and purplish above, red beneath: fls. in cymes, large, rose-colored; sepals with long hairs at the base.—Intro. 1884.

95. **cathayàna,** Hemsl. (*B. Bowringiàna,* Hort., not Champ.). Fig. 524. A beautiful ornamental-lvd. species, named in 1908: sts. fleshy and crimson-hairy, 18 in. high: lvs. hanging much like the Rex varieties, large, obliquely cordate, long-pointed, toothed and serrate, green with crimson nerves above and bright mottled crimson beneath, very showy: fls. large for the group, vermilion. Sept. China. B.M. 8202.—It propagates readily from cuttings of both sts. and lvs. It has been hybridized with *B. Rex,* producing very richly colored foliage. *B. Bowringiana,* Champ. B.M. 5182, is distinct from *B. cathayana,* and apparently is not in cult.; but the *B. Bowringiana* of gardens, as figured in G.C. Apr. 18, 1903 suppl., is the plant here described.

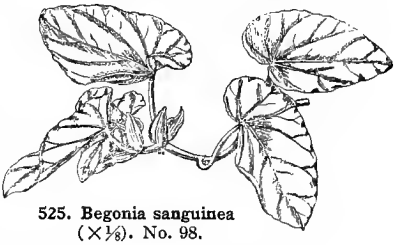
96. **deliciòsa,** Lind. Plant the size of *B. Rex,* but smooth or nearly so: lvs. large, obliquely cordate-ovate, many triangular-toothed or -lobed, marked above with many gray blotches, reddish beneath: fls. in dense clusters, pink, produced in winter. Ceylon.

97. **laciniàta,** Roxbg. Erect, 1–2 ft., becoming straggling, the sts. green: lvs. roundly ovate, sharply lobed, pubescent, black-purple, with a broad zone of green, reddish on the under side: fls. as in *B. Rex.* India, S. China. B.M. 5021. G.C. III. 34:368.—Odd.

DD. *Whole plant smooth.*

E. *Lvs. thick, broad and entire, often peltate.*

98. **sanguínea,** Raddi. Fig. 525. Very smooth and shining: sts. perennial, woody at the base, red: lvs. 4–6 in. long, subpeltate, obliquely cordate, abruptly pointed, thick, fleshy, bright green above, blood-crimson below: fls. small, white. Brazil. B.M. 3520.—A handsome evergreen-foliaged begonia, notable for its brilliant red-lined thick-edged lvs.



525. Begonia sanguinea (×⅙). No. 98.

EE. *Lvs. medium, stiff, green and shining.*

F. *Fls. white.*

99. **angulàris,** Raddi (*B. zebrìna,* Hort.). Smooth, shrubby, very tall (to 8 ft.), much branched, the branches spreading or drooping: lvs. elongate, ovate-acuminate, shiny dark green, veins white, pale green and reddish tinged beneath, the margins undulate and crenate-serrate: fls. small (⅔in. across) and many in large cluster, white. Brazil. B.M. 7842.—A striking plant.

100. **ulmifòlia,** HBK. (*Donáldia ulmifòlia*, Klotzsch). Tall, green, the st. 4-angled and grooved, shedding its hairy scurf: lvs. small and elm-like (whence the name), thinly hairy, green on both sides: fls. white, small. Colombia. Gt. 1854:93.—Very free-flowering when grown large, the fls. appearing in winter and early spring.

526. Begonia nitida (×⅓). No. 104.

101. **lôngipes,** Hook. Tall and stout (3 ft. or more), the st. furrowed and more or less glandular but otherwise the plant green, smooth and shining: lvs. ample, reniform or nearly orbicular, oblique or lop-sided, glossy, serrate: fls. small, white, numerous in a long-stalked cluster, winter-blooming. Trop. Amer. B.M. 3001.—In some forms, the peduncles are excessively long.

102. **undulàta,** Schott. Plant green and shining, although somewhat hairy when young: lvs. 2-ranged, oblong, very short-stalked, acuminate, wavy or undulate on the margins: fls. rather small, white, in short axillary clusters, the pistillate ones long. Brazil. B.M. 2723.

103. **kewénsis,** Hort. Like *B. undulata:* slender, with spreading or drooping leafy branches: lvs. ovate to cordate-ovate about 6 in. long, smooth and shining, green: fls. many, in large clusters, small, white or slightly cream-colored, ½in. across. Of garden origin.—There is a hybrid between this and *B. coccinea.* A good basket plant.

FF. *Fls. colored.*

104. **nítida,** Dry. (*B. mìnor,* Jacq. *B. speciòsa,* Hort. *B. obliqua,* L'Her.). Fig. 526. Smooth: st. 3–4 ft. high, perennial, fleshy, woody at the base when old: lvs. obliquely ovate, wavy, 4–6 in. across, glossy dark green: fls. on long, axillary peduncles, pale pink, with a silvery blush; males 1½ in. across, with 2 broad and 2 narrow petals; females smaller, with 5 equal petals. Jamaica. B.M. 4046. A.G. 24:575. Gt. 2:192.—A very useful plant in the greenhouse, flowering all winter. Also interesting on account of being probably the first begonia intro. to cult. in Eu. (1777, at Kew, by Wm. Brown). Var. **odoràta álba** is a very handsome variety of this species, which has smaller fls. of the purest white and sweet-scented. **Dr. Nachtigal** (*B. nítida* var. *odoràta álba* × *B. Lynchedna*), is similar in general form to the latter, but has fls. of a delicate rose-pink, especially on the inner surface of petals.

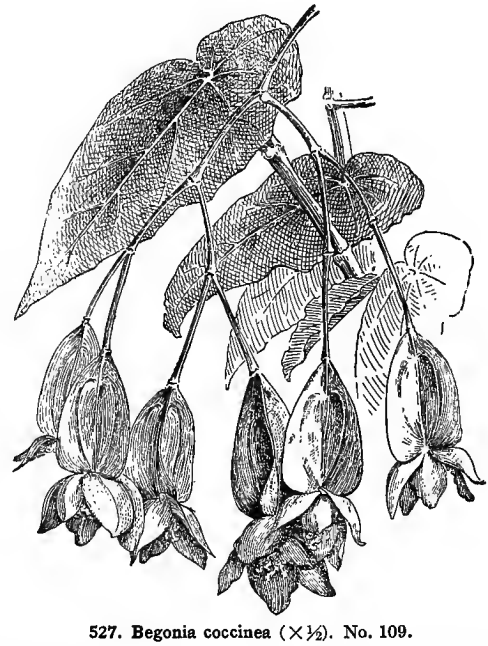
105. **Teùscheri,** Lind. Stout: st. 2–6 ft. high, erect, strong grower: lvs. large, oblique, fleshy, acutely lobed, ovate-lanceolate, margins serrate, bright green above, with large grayish blotches or in one form with dots, red and strongly veined beneath: fls. in axillary clusters, bright red, large. Malaya. I.H. 26:358.

106. **Bismarckii,** Veitch. Lvs. large and lobed, oblique, acuminate-pointed, 6 in. long: fls. in drooping clusters, satiny rose, males insignificant, females 1½ in. across and making a gorgeous display.—Very similar to *B. Teuscheri.*

107. **carminàta,** Veitch. A handsome hybrid, the result of a cross between *B. coccinea* and *B. Dregei:* plant erect or nearly so, branching freely: st. green, shining: lvs. obliquely ovate-acuminate, deeply toothed, light green: fls. rosy scarlet in large pendulous cymes.—The male fls. do not remain on the plant long, the main feature being the large bright rosy scarlet female fls. and their brightly colored ovaries which remain on the plant for a considerable period. In this respect it greatly resembles its parent, *B. coccinea.* It is a very fine greenhouse plant and should be in every collection.

108. **polyántha,** Hort. Sts. green, red at the nodes, erect, free-branching: lvs. elliptic, rich green, glabrous or nearly so; petioles reddish green, 2–3 in. long: infl. numerous, 10–20-fld.; fls. pink, ¾–1 in. diam. Mex.—A strong-growing species of quick growth and producing a mass of charming fls. all over the plant in winter and early spring. One of the finest and best of the winter-flowering begonias. The plants often supplied as *B. natalensis* are said to be this species.

109. **coccínea,** Hook. (*B. rùbra,* Hort. *B. maculàta* var. *corallina,* Hort.). Fig. 527. Smooth: sts. tall, succulent: lvs. on short petioles, obliquely oblong, angular, with wavy red margins, 4–6 in. long: fls. deep coral-red; males ½in. across, with 4 unequal petals; females more attractive, owing to the length and rich color of the



527. Begonia coccinea (×½). No. 109.

ovary, which has 3 small subequal wings. Brazil. B.M. 3990.—The fls. are very persistent and exceedingly ornamental, especially when planted out. Thrives well in a warm airy greenhouse. One of the most attractive and best-known members of the genus. It has been largely used by the hybridist, the well-known

President Carnot being one of its offspring. Intro. from the Organ Mts. of Brazil by William Lobb in 1841.

EEE. *Lvs. medium to large, the margins strongly toothed, incised or lobed.*

F. *Fls. white.*

110. **Madame de Lesseps.** Fig. 528. Showy, strong, erect grower: lvs. acutely lobed, large, margins serrate, green above, red and strongly veined below: fls. large, white, in axillary clusters, males small. Garden origin.

528. Begonia Madame de Lesseps (×½). No. 110.

111. ólbia, Kerchove. Erect, the st. 2–3 ft. high: lvs. lobed, hairy and olive-green above, smooth and red beneath, margins reddish, petioles grooved, smooth, veins prominent as dark lines: fls. concealed by lvs., in small clusters directly on the st. without peduncles, large, white, male and female in same cluster. Brazil.

FF. *Fls. colored, varying to tinted white.*

112. **argénteo-guttàta,** Hort. (*B. álbo-pícta* × *B. ólbia*). Fig. 529. Profusely branching: lvs. shining green, ovate-acuminate, slightly lobed, smooth, 2½ in. wide, 3–5 in. long, thickly dotted with white spots: fls. in clusters, variable; petals white, tinged with pink: caps. rose-pink.—Intro. by Lemoine, 1889. Well worth a place in a collection on account of its decorative foliage.

113. **maculàta,** Raddi (*B. argyrostígma,* Fisch.). Very smooth: st. erect, 2–3 ft., branching, woody when old: lvs. cordate, lanceolate, wavy, 4–6 in. long, upper surface sometimes with large white roundish or circular spots: fls. pale rose or white, males with 2 ovate and 2 narrow petals, females with 5 equal petals. It includes several forms. Brazil. B.R. 666. Var. **argyrostígma pícta,** Hort., is a common form, with very large white spots on the lvs. An old greenhouse or conservatory plant. Var. **elegantíssima,** Hort., a variety with more slender habit of growth than the type and only sparingly maculated on the lvs., but forming a large free-branching specimen. Var. **Wrightii,** Hort., a variety with large lvs. heavily maculated with white, especially in the young state: infl. pendulous, 10–20-fld.; fls. white, an in. diam.; males short lived; females greenish white, remaining on the plant for several weeks.—This variety does not branch very freely as with the preceding variety but has the habit of sending up long stout shoots, 6 or 8 ft. high, from which the fine handsome clusters of fls. hang in the form of a chain.—**B. coralìina,** Hort., is a free-flowering form, useful for conservatory, 8–10 ft. on rafters: lvs. dark glossy green, almost covered with bright coral-red long fls. in large drooping trusses. J.H. III. 51:339.

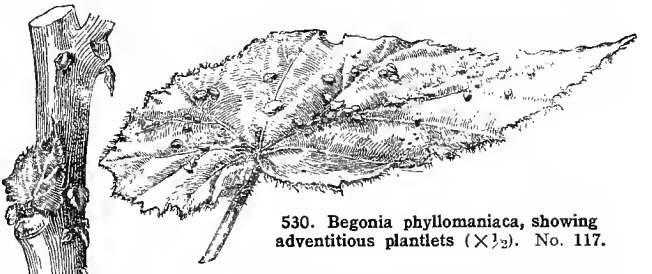
529. Begonia argenteo-guttata (×⅙). No. 112.

114. **Thúrstonii,** Hort. (*B. metállica* × *B. sanguínea*). Smooth and shiny: st. 2 ft. high: lvs. orbicular-acuminate oblique, rich purple, red on the under side, veins prominent: fls. insignificant, small, rosy white, on slender peduncles. A.F. 7:729.—Excellent for bedding on the north side of a building, and as a pot-plant. Originated with C. Thurston, Paterson, N. J.

115. **díchroa,** Sprague. A tall-growing species but often remaining dwarf, woody in lower parts, habit half-pendulous: sts. green in upper parts only: lvs. large for so dwarf a plant, elliptic-ovate, 6–12 in. long, rich green, glabrous on both sides, occasionally toothed, prominently veined: seedling plants beautifully maculated with white when young but the spotting is entirely lost in the adult stage: infl. dense, short, hidden amongst the upper lvs.; fls. large; males occasionally 2 in. diam., petals 4, rich brick-red; females smaller, ovaries brick-red shaded with white and prominently winged. Brazil. B.M. 8412.—A distinct and handsome species, useful as a basket-plant.

116. **coronàta,** Hort. (*B. caroliniæfolia* × *B. polyántha*). St. shrubby, coarse, 2–3 ft. high, covered with numerous withered stipules: lvs. large, lobed, on long petioles: fls. pale pink, with large, somewhat drooping cymes.

117. **phyllomanìaca,** Mart. Fig. 530. Hairy and shaggy: st. perennial: lvs. obliquely cordate, attenuate, 4–6 in. long, slightly laciniated and fringed: fls. pale pink. B.M. 5254. Brazil.—This species is peculiar in producing from the st., petioles and lvs. innumerable buds and small growths. It is one of the most interesting of plants. It is covered with small fls. in early spring.



530. Begonia phyllomaniaca, showing adventitious plantlets (×½). No. 117.

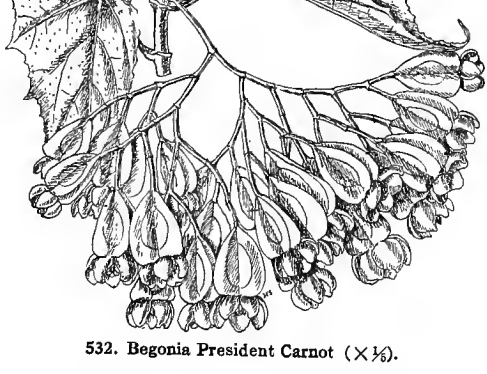
118. **President Carnot,** (*B. coccínea* × ———?). Figs. 531, 532. Plant, 2–6 ft. high, spreading: lvs. ovate-lanceolate, acute-lobed, ribs on the under side red: fls. in a large cluster; males small, insignificant; females large, bright red-carmine, 2 in. long, including caps.—A striking and handsome plant and one that should be in all collections. It is of very easy

531. Begonia President Carnot. No. 118.

cult. and each shoot bears 1–3 of its immense clusters of brilliant female fls.

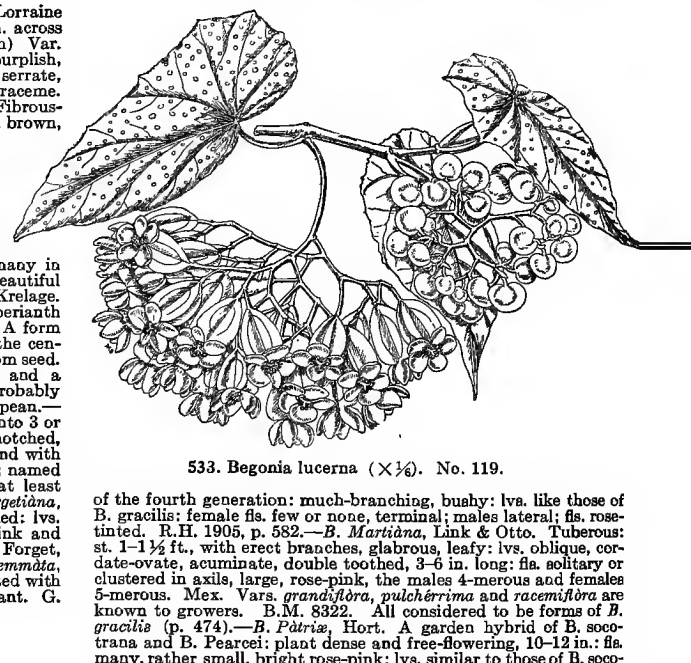
119. **lucérna,** Hort. Fig. 533. Hybrid of exceptional merit, with habit and constitution of President Carnot: lvs. heavily spotted with white, specially when young: fls. in long pendulous clusters that are often 1 ft. in diam.; male fls. 1 in. across; females much larger, with bright pink ovaries, giving the plant a distinctive appearance as they persist for many weeks.—The plant succeeds well in a warm greenhouse. Should be in every collection. Named for Lucerne, where it originated. Intro. to commerce in 1903.

B. amábilis, Hort. A large-fld. form of the Gloire de Lorraine class, the clear brilliant pink blossoms being nearly 1½ in. across (Rochford).—*B. Balmisiàna,* Ruiz (B. populifolia, Kunth) Var. *mitellifòlia,* Dav. Tuberous rootstock: st. simple, erect, purplish, pubescent: lvs. reniform, obscurely lobed, irregularly serrate, whitish tomentose beneath: fls. pale rose, in a terminal raceme. Mex. R.H. 1911, p. 43.—*B. Bárkeri,* Knowl. & Wesc. Fibrous-rooted: stiff, erect, sparsely branched: sts. somewhat woody, brown, densely hairy: lvs. peltate, ovate, acute, lobed, serrate, 5–7 in. long, light green in color; veins pale yellowish green; petioles long and fairly stout: infl. large and spreading, freely branched; fls. pink, produced in early spring. Mex.—A distinct and pretty begonia.—*B. calabárica,* Stapf. St. short and prostrate: lvs. peltate, oblique, broadly cordate-ovate, 2–3 in. long, ciliate on margins: fls. red, small. Calabar, W. Trop. Afr.—*B. crassicáulis,* Hort. (Lindl.?). Lvs. large, nearly circular, coriaceous, clear green: fls. many in vertical clusters, small, rose-white, the bloom being more beautiful than that of B. manicata, which it resembles.—*B. crispa,* Krelage. Fls. large, on long, erect peduncles above the lvs., the 5–8 perianth segms. crispate. Country unrecorded.—*B. cristàta,* Hort. A form or race of tuberous begonias with a crested outgrowth in the center of the fl.: the race is fixed and comes more or less true from seed.—*B. eláticr,* Hort. Veitch, is a cross between B. socotrana and a tuberous begonia.—*B. Elsmeri,* Hort. Of garden origin, probably hybrid: fls. stellate, large, flesh-colored, in winter. European.—*B. Faureàna,* Garn. Lvs. palmately parted to the middle into 3 or 5 main divisions and these divisions again parted or notched, beautifully colored with silvery white on a green ground and with brown-green on the ribs. Brazil. Intro. to France in 1892; named for the former President of France. I.H. 42:34.—Some at least of the B. platanifolia of gardens is this species.—*B. Forgetiàna,* Hemsl. Fibrous-rooted: nearly 2 ft., more or less branched: lvs. fleshy, glossy green, 6–7 in. long and 2 in. broad: fls. pink and white, 1 in. across, in clusters. Brazil.—Named for L. Forget, collector for Messrs. Sander. Allied to B. undulata.—*B. gemmàta,* Hort. (B. decora × B. Rex var.). Lvs. angled, Rex-like, dotted with silver on a green ground: very attractive as a specimen plant. G.



532. Begonia President Carnot (×⅙).

22:123.—*B. gigantèa,* Hort. Rootstock woody: st. 2–3 ft.: lvs. caudate-acuminate, becoming 1 ft. long: fls. many, small, white or pale pink. It is probably a form of garden origin.—*B. Gilsonii,* Hort. Plant, 2 ft. high: st. shrubby, coarse: lvs. large, lobed: fls. on long, erect peduncles, pale pink.—Interesting as being a double-fld. fibrous-rooted begonia. Named for Gilson, colored gardener to Mrs. Livingston, N. Y.—*B. Héddei,* Warb. Tall, branching: lvs. triangular-ovate or broadly elliptic, acuminate, jagged and notched and usually lobed toward the base, green above and red beneath: fls. light rose, borne amongst the lvs. German E. Afr.—*B. Ideàla,* Hort. Veitch. Neat dwarf plant, B. socotrana × a tuberous begonia: 6 in.: fls. semi-double, 2 in. across, brilliant rose, long-lasting: winter. Gn. 61, p. 13. R.H. 1906, p. 131.—*B. Kümmeriæ,* Gilg. Fibrous-rooted: st. erect and free-branching, green suffused with red: lvs. ovate, 6 in. diam., shining, green veins and petiole red: infl. short, few-fld.; fls. blush-white, tipped with rose; male, ¾ in. diam., female with bright yellow stigmas; ovary 3-celled bluntly triangular, swelling up to a large fleshy fr. some 2 in. long. Trop. Afr.—*B. Kunthiàna,* Walp. St. erect: lvs. lanceolate, acuminate, serrate, smooth, green above, red below: fls. white, large. B.M. 5284. Brazil.—*B. Léhmbachii,* Warb. Allied to B. Heddei: herb, erect, 8–16 in., the sts. fleshy and red: lvs. oblique, 4–5 in. long, irregularly 5-lobed, dentate, light green and somewhat hairy above, red-green beneath: fls. axillary, small, tinted and red-striate. German E. Afr. Gt. 49:1476.—*B. Lindleyàna,* Hort.=B. incarnata.—*B. lobulàta,* A. DC. Fibrous-rooted: erect, branching: sts. light green: lvs. highly glabrous, pale green, ovate-acute, serrate, occasionally lobed, prominently veined, 6–8 in. long; petiole red: infl. rather short, densely fld.; fls. small, white. Mex.—*B. longicýma,* Bellair, is a garden hybrid of B. Schmidtiana and B. semperflorens,



533. Begonia lucerna (×⅙). No. 119.

of the fourth generation: much-branching, bushy: lvs. like those of B. gracilis: female fls. few or none, terminal; males lateral; fls. rose-tinted. R.H. 1905, p. 582.—*B. Martiàna,* Link & Otto. Tuberous: st. 1–1½ ft., with erect branches, glabrous, leafy: lvs. oblique, cordate-ovate, acuminate, double toothed, 3–6 in. long: fls. solitary or clustered in axils, large, rose-pink, the males 4-merous and females 5-merous. Mex. Vars. *grandiflòra, pulchérrima* and *racemiflòra* are known to growers. B.M. 8322. All considered to be forms of *B. gracilis* (p. 474).—*B. Pátriæ,* Hort. A garden hybrid of B. socotrana and B. Pearcei: plant dense and free-flowering, 10–12 in.: fls. many, rather small, bright rose-pink: lvs. similar to those of B. socotrana. (Lemoine.)—*B. Pöggei,* Warb. Fibrous-rooted: erect or spreading: sts. terete, woody in lower part, dull brownish green: lvs. only slightly oblique, elliptic, 4–6 in. long, dark green above, suffused with red beneath: infl. in short axillary clusters; fls. small, white veined with red, female with rather narrow petals; ovary distinct terete, not winged, bright red, 1–2 in. long: whole plant covered with rufous hairs. A remarkably distinct begonia, but of little horticultural value.—*B. pruinàta,* A. DC. St. erect or spreading, seldom branched, covered with greenish white spots: lvs. peltate, fleshy, on long terete petioles, spreading or erect; blades broadly ovate, lobed and undulate, dark green above, with prominent veins of a greenish yellow color, and dull grey beneath: infl. erect, large, branching freely; fls. pure white. Costa Rica. A fine winter-flowering species.—*B. pyramidàlis,* Lemoine. B. manicata × B. caroliniæfolia: lvs. large, palmate, entire, thick, brilliant green: fls. large, in panicles, white-rose or rose-tinted.—*B. Queen.* A garden hybrid; fibrous-rooted: erect with brilliant-colored foliage: sts. green, terete: lvs. ovate-acuminate, undulate, finely serrate, upper side a brilliant purple-red, the veins being green, under side bright red: fls. rosy red seldom produced. One of the finest and most ornamental of the fibrous-rooted begonias. It is somewhat difficult to grow into a large specimen and should be kept slightly drier at the roots than most plants of this section.—*B. Reichenheimii,* Hort. (B. rubella × B. heracleifolia). Lvs. all basal, large and long-petioled, parted to the middle: fls. on sts. upright above the lvs. Gt. 52, p. 207.—*B. Röchfordii,* Hort., is a bright rosy carmine begonia of the Gloire de Lorraine type, with larger fls. and foliage. F.E. 31 (1911), p. 434.—*B. Saúlii,* Hort., named for the

late John Saul, was intro. from Guatemala: resembles B. Feastii in the shape and color of its lvs., but with a distinct red sinus at junction of petiole with lf. Probably not now cult. under this name.—*B. scéptrum*, Hort. Erect, sparsely branched: sts. light brown colored with red on young growth: lvs. large, broadly ovate, deeply lobed, margins serrate, pale green suffused with red and irregularly blotched with white, prominently veined on the underside; petioles bright red: fls. 10–20 in a cluster, pink or white.—*B. stigmósa*, Lindl. St. a short, creeping rhizome: lvs. large, cordate-acute, irregularly toothed, smooth above, hairy beneath, green, with purple-brown blotches: fls. insignificant, white, in cymose panicles. Mex.—*B. Stúrzii*, Hort. A floriferous form of B. semperflorens, with rose-pink fls. in broad panicles, and lvs. white-spotted.—*B. subpeltàta nigricans*, Hort. (B. nigricans, Hort.). Plant 2–3 ft. high: lvs. ovate, acuminate, blood-red below, silvery and slightly hairy above, 4–8 in. long, 2–4 in. across: fls. rose-pink, profuse: caps. wings equal, pink. Very useful for decoration. Var. *Pres. de Boureuilles*, Hort., has lvs. of a much richer color, and more profusely studded with red hairs: fls. of a deeper pink.—*B. Témplinii*, Hort. Sport from B. phyllomaniaca var. variegata: differs in having its regular blotches over the face of the lvs. varying from true yellow to light sulfur-color, often with blending of shades of pink: 2½–3 ft.: lvs. oblique, the margins ruffled and fringed. Originated with H. G. Wolfgang, of the Templin Co., Calla, Ohio, and put in the trade in 1905. F.E. 18:258.—*Tree.* A group of large-growing begonias produced by Mrs. Theodosia B. Shepherd, Calif. Some of them are described as a cross of Gloire de Jouy by Rubra, having the cane-like growth of Rubra (*B. coccinea*), with its long-stemmed fls. but larger sepals and pistils; lvs. illuminated with red, terra-cotta, pink and yellow. Other giants are seedlings of Pink Rubra, with stronger canes, larger lvs., and more beautiful fls., the lvs. on young growth spotted with silver (Princess Alice, Rubra Bamboo, Striking Beauty, Hebe and others, are of this parentage). —*B. unifòlia*, Rose. A singular begonia from Mex., recently described (Rep. Mo. Bot. Gard., 1904, p. 79, Fig. 28): tuberous-rooted: lf. 1, lying on the ground, sessile, nearly orbicular, double-toothed: fls. on slender scape to 2 ft. high, nearly white. Not in the trade.—Voss. has called the hybrids of the rhizomatous group *B. rhizohýbrida* and of the fibrous-rooted upright caulescent group *B. caulohýbrida;* these names represent such various and often unlike forms that they will probably have little application in common practice, although useful for taxonomic purposes.

L. H. B.

BELAMCÁNDA (East Indian name). *Iridàceæ.* Blackberry Lily. Leopard Flower. A hardy, herbaceous perennial, which is an old garden favorite. The first of the popular names comes from the clusters of shining black roundish seeds, and the second from the flower, which is orange, spotted red. It is more commonly sold as a Pardanthus, which also means leopard flower.

534. Belamcanda chinensis. (×⅓)

Perianth segms. oblong, the 3 inner slightly shorter and spirally twisting as they fade: stamens in one group only at the base: caps. pear-shaped, the valves ultimately falling away. Prop. by seeds or by division. Of easy culture in rich, sandy loam and in a sunny place. Sometimes, but incorrectly, spelled Belemcanda. One species.

chinênsis, DC. (*Gemmingia chinénsis*, Kuntze. *B. punctàta*, Moench. *Ixia chinénsis*, Linn. *Morèa chinénsis*, Thunb. *Pardánthus chinénsis*, Ker. *P. sinénsis*, Van Houtte). Fig. 534. Height 2–3 ft.: rootstock short, stoloniferous lvs. about 6, equitant, striate, 1–1½ ft. long, 1 in. broad: outer spathe-valves ½–1 in. long: pedicels 1–2 in. long: caps. 1–1½ in. long; valves reflexing, persistent. China and Japan. B.M. 171 (as Ixia). F.S. 16:1632. L.B.C. 19:1874.—The seed-stalks are sometimes used with dried grasses for decoration. It is said that the birds sometimes mistake the seeds for blackberries. N. Taylor.†

BELGAUM WALNUT: *Aleurites.*

BELLADONNA: *Atropa.*

BELLADONNA LILY: *Amaryllis.*

BELLFLOWER: *Campanula.*

BELLIDIÁSTRUM (*daisy* and *star*), is now referred to Aster. **B. Michéllii,** Cass. (*Aster Bellidiástrum*, Scop.), is a small European composite, 1 ft., perennial, with white heads single on naked scapes and lvs. in a rosette, sometimes planted but probably not in Amer.

535. Bellis perennis. (×½)

BÉLLIS (Latin, *bellus*, pretty). *Compósitæ.* English Daisy. The true daisy: a low perennial with single heads on scapes, planted in borders and edgings and naturalized in grass land. Fig. 535.

The daisy, as it grows wild in England, has a yellow center, surrounded by numerous rays in a single row, but the favorite cult. forms are double, the rays rising in tier upon tier, and frequently crowding out every trace of a yellow center. The English daisy is essentially a pink or pinkish fl. in its general effect, the tips of the rays sometimes and the under surfaces usually being pink or red. There are about 10 species in the genus, only one of which is American. *B. integrifolia* is found in moist soil from Ky. and Tenn. to Ark. and Texas, but is too rare and sectional to become a general favorite. The plant that is most commonly called daisy in Amer. is *Chrysanthemum Leucanthemum.* For a list of the various plants known as daisies in Amer., see *Daisy.*

Daisies are favorite border plants, and are much used in spring bedding, especially for edging. They thrive in a cool soil and moist atmosphere, and are, therefore, much better adapted to English than American gardens. They can be grown, however, in a cool greenhouse where they will flower profusely during February and March. Although the English daisy is a perennial, it can be very easily grown as an annual. A light mulch is desirable for winter protection. In home gardening, the plants, after flowering, are divided into single crowns. These are planted about 6 inches apart in good rich garden soil. Each crown soon sends out side growths, which, in time, form new crowns. Before winter sets in the young clumps can be moved readily to any place in the garden in which they are wanted to bloom. Daisies are also forced by florists for winter bloom. When daisies are desired for edging spring flower-beds, the clumps are divided into single plants during the previous September, or early enough to allow the new plants to get a firm hold before winter, and are placed 3 inches apart in a narrow trench. These edgings must be renewed each year, as the plants, if they grow well, spread too wide, or irregularly. In dry summers many roots fail, and if they remain in the same spot year after year, the flowers will degenerate to the single condition.

The simplest way of propagating and growing English daisies for spring bedding in this country is to

sow the seed in shallow boxes about August 10. As soon as large enough to handle, transplant 5 inches apart into coldframes, and when the winter sets in put on the sash, giving air whenever the weather may be mild. Transplant to the flower beds as early as possible in the spring, where in a very short time they will be a mass of bloom, and will continue to bloom till the beginning of June, when they should be thrown out, and the summer bedding plants put in. Longfellow and Snowball are the two best varieties for this purpose. *Myosotis alpestris* and *Silene pendula* may be grown the same way, using the daisies as edging when in the beds, and the others as center pieces.

The daisy is propagated by seeds (which are sown early), and by divisions, the choicest varieties being maintained by the latter method. The main types grown from seed are the white, rose, quilled, and white with red center, all of which are double. A dark red is less common. Of kinds propagated by seed, Longfellow is now the best rose-colored, and Snowball the best white variety, the latter being especially prized by florists for cut-flowers, as it has long, stiff stems. Other varieties are Maxima, Snowflake, and Rob Roy, which is perhaps the best red.

perénnis, Linn. TRUE or ENGLISH DAISY. Hardy herbaceous perennial, 3–6 in. high: lvs. clustered at the root, spatulate or obovate: fls. 1–2 in. across, solitary, on hairy scapes. Apr.–June. W. Eu.; escaped in Calif.; rarely runs wild in the eastern states. B.M. 228. F.S. 6:584, which shows 11 well-marked types.—An interesting but not permanent form is the "hen-and-chickens daisy," in which a number of small fl.-heads are borne on short stalks springing out of the main fl.-head. Cockscomb forms, in which several scapes unite to produce a monstrous fl., are sometimes seen, but cannot be perpetuated. The rays are sometimes wholly incurved, or reflexed, or quilled. Other English names of the daisy are herb Margaret, ewe- or May-gowan, childing daisy, bone- or bruisewort, bone flower, March daisy, bairnwort.

J. B. KELLER, E. J. CANNING, and WILHELM MILLER.

BÉLLIUM (from its resemblance to *Bellis*, the daisy). *Compósitæ*. Miniature plants, sometimes planted in rock-gardens.

Leaves crowded or in a rosette, from which arise scapes bearing a single daisy-like head or "flower," white, with light yellow disk: differs from Bellis largely in its pappus, which is unequal and double, of bristles and scales.—Four to 6 species in the Medit. region, annual and perennial. Require treatment given rock-plants and sod-plants.

bellidioìdes, Linn. Annual, 2 in., with creeping stolons: lvs. spatulate: heads white, all summer.—Like a miniature daisy. Apparently little known in this country.

L. H. B.

BELLWORT: In England, any member of the *Campanulaceæ*. In America, *Uvularia*.

BÈLOU (Brahman name for the Bael fruit). *Rutàceæ*, tribe *Citreæ*. An older name for Ægle, recently reinstated by American taxonomic botanists. See description under *Ægle*.

B. Mármelos, A. B. Lyon,=Ægle Marmelos, the Bael fruit of India. *B. glutinòsa*, Skeels=Chætospermum glutinosa, Swingle.

BELOPERÒNE (name refers to the arrow-shaped connective). *Acanthàceæ*. Hothouse evergreen shrubs of the Justicia group, rarely seen in cult. and apparently not in American trade. Lvs. entire: fls. usually red or purple, mostly in showy-bracted axillary or terminal clusters; corolla-tube narrow, often long, the limb 2-lipped; stamens 2, affixed on the tube; style filiform, entire or slightly 2-lobed: fr. an oblong or ovoid caps.—About 30 species inhabiting Trop. Amer., of which 2 or 3 are listed as cult. plants. **B. violàcea,** Planch. & Lind., has lanceolate-acuminate lvs. and violet-purple fls. B.M. 5244. **B. oblongàta,** Lindl., has oblong-lanceolate lvs. and axillary spikes of rose-purple fls. B.R. 1657. A recent species is **B. angustiflòra,** Stapf, resembling *B. violacea*, with oblong-elliptic lvs. and a very narrow corolla-tube with a violet-purple limb.

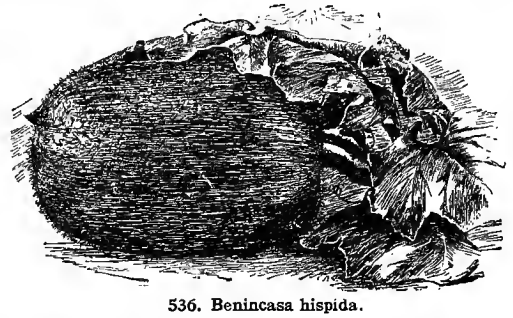
BELVIDERE, or SUMMER CYPRESS: *Kochia*.

BENE: *Sesamum*.

BENI, JAPANESE: *Caroypteris Mastacanthus*.

BENINCÀSA (name of an Italian nobleman). *Cucurbitàceæ*. Annual running squash-like herbs grown sparingly for the edible fruits.

Leaves 5-lobed soft-hairy: fls. solitary, yellow, monœcious, the staminate long-peduncled, the pistil-



536. Benincasa hispida.

late nearly sessile; corolla deeply lobed; tendrils 2–3-branched.—Two species in Trop. Asia.

híspida, Cogn. (*B. cerífera*, Savi). Fig. 536. WAX GOURD. WHITE GOURD of India. ZIT-KWA. CHINESE PRESERVING MELON. CHINESE WATERMELON. Vine long, like a muskmelon, hairy, with cordate lobed lvs.: fr. mostly oblong, 10–16 in. long, hairy, white-waxy, with solid white flesh and small cucumber-like seeds. Cult. the same as muskmelon or cucumber. R.H. 1887:540.—Used for making preserves and sweet pickles; said to be eaten raw in warm countries, and the unripe frs. to be employed by natives in India in the making of curries.

L. H. B.

BENJAMIN BUSH: *Benzoin æstivale*.

BENT-GRASS: *Agrostis*.

BENTHÁMIA: *Cornus*.

BENTÍNCKIA (named for Lord Bentinck, governor of Madras, 1803–1805). *Palmàceæ*, tribe *Géonomeæ*. Tall stately unarmed palms, with equally pinnate, terminal leaves; not as yet well known to the trade, but deserving greater attention.

Leaves of many lfts. which are usually 2-lobed at the apex: spathes many, the 2 lower short and incomplete; spadix arising from among the lvs., branched; fls. small, monœcious or polygamous: fr. small, almost round, with a single seed pendulous from the top of the cavity.—There are only 2 species, both Indian. G.C. II. 22:595.

The following is a graceful palm "in general appearance not unlike the coconut palm, than which it is, however, much more graceful." The young leaves for the first year are bi-partite, quite like young coconut palms.

They should be grown in a warmhouse, never less than 60°, and should be given plenty of water at all seasons. A mixture of rich loam and peat or leaf-mold, half and half, makes the best medium for growth.

nicobàrica, Becc. ORANIA. St. 50–60 ft., solitary, usually from 7–10 in. thick: lvs. 5–8 ft. long; lfts. 1–2 ft., sessile, linear and leathery, the tips distinctly 2-lobed; petiole and rachis glabrous, the former short:

spadix 1½–2 ft., many times branched, the branchlets inserted in woolly grooves: fr. about as large as a cherry. India. R.H. 1896, p. 249. N. TAYLOR.

BÉNZOIN (of Arabic or Semitic origin, meaning *a gum* or *perfume*). Syn., *Lindera. Lauràceæ.* Ornamental woody plants, grown chiefly for their handsome aromatic foliage; some species also for their early yellow flowers and the brightly colored fruits in autumn.

Aromatic shrubs or trees: lvs. alternate, entire or 3-lobed, deciduous or persistent: fls. polygamous or diœcious, apetalous, small, in axillary clusters with an involucre of 4 deciduous scales; sepals 6, rarely more; staminate fls. with 9 stamens, pistillate with a globose ovary and 9–15 staminodes: fr. a 1-seeded drupe. —About 60 species, if Daphnidium and Aperula are included, in Temp. and Trop. E. and Cent. Asia and in N. Amer.

Some Asiatic species yield an odorous oil used in perfumery. The cultivated species, with the exception of *B. gracile*, are deciduous shrubs, with yellow flowers in small clusters before the leaves and red or black fruits in autumn. *B. æstivale* is hardy North and *B. obtusilobum* has proved hardy at the Arnold Arboretum in a sheltered position; *B. hypoglaucum* is of about equal hardiness; the other species are more tender.

They thrive best in peaty or sandy and moist soil. Propagation is usually by seeds, which must be sown after maturity, as they soon lose their vitality; also by layers, which root best in peaty soil; of greenwood cuttings under glass, one-half may be expected to root. The benzoin of the druggists is a balsamic resin obtained from *Styrax Benzoin*.

æstivàle, Nees (*Bénzoin Bénzoin,* Coulter. *B. odoríferum,* Nees. *Líndera Bénzoin,* Blume). SPICE BUSH. BENJAMIN BUSH. WILD ALLSPICE. FEVER BUSH. Fig. 537. Shrub, 6–15 ft., nearly glabrous: lvs. oblong-obovate, finely ciliate, bright green, pale beneath, 3–5 in. long: fls. yellow, before the lvs.: berry red, oblong, spicy. New Eng. southward and west to Kan. Em. 365.—The bark is aromatic, stimulant, tonic, astringent; the fr. is likewise used medicinally. The shrub is attractive in early spring with its yellow, small, but numerous fls., and handsome in autumn with its foliage turning clear yellow and studded with the scarlet frs.

537.
Benzoin æstivale.
(×½)

B. grácile, Kuntze (Daphnidium gracile, Nees). Lvs. ovate, 3-nerved, chartaceous, persistent. Habitat unknown. Stove plant. —*B. hypoglaùcum,* Rehd. (Lindera hypoglauca, Maxim. B. hypoleucum, Kuntze). Lvs. penninerved, glaucous beneath: clusters few-fld., with or before the lvs.: berries black. Japan.—*B. melissifòlium,* Nees. Allied to B. æstivale. Branches pubescent: lvs. oblong, downy beneath. Southern states. B.M. 1470.—*B. obtusilobum,* Kuntze. Large shrub with very handsome foliage: lvs. 3-nerved, ovate or 3-lobed, grayish green and nearly glabrous beneath, 2–4½ in. long: clusters many-fld.: berries black. Japan. G.F. 6:295. S.I.F. 1:44.—*B. prœcox,* Sieb. & Zucc. Lvs. penninerved, elliptic-oblong, greenish beneath, acuminate: clusters few-fld., before the lvs.: berries brownish, ½in. diam. Japan. S.I.F. 2:19.—*B. sericeum,* Sieb. & Zucc. Lvs. penninerved, grayish pubescent beneath: clusters many-fld., with the lvs. Japan.

ALFRED REHDER.

BERBERIDÓPSIS (from *Berberis* and Greek *opsis, likeness*). *Flacourtiàceæ.* Ornamental shrub cultivated for its crimson flowers and evergreen foliage.

Branches slender, terete: lvs. alternate, petioled, dentate: fls. perfect, long-pedicelled, in terminal racemes; bracts, sepals and petals gradually passing into one another, 9–15, the inner ones concave, larger; stamens 7–10 with very short filaments; ovary superior, 1-celled with many ovules; style short, with 3-lobed stigma: fr. a berry.—One species in Chile.

This is a low, glabrous, slightly climbing shrub, with deep green foliage and crimson flowers in drooping racemes, for temperate regions or the cool greenhouse, growing in almost any soil. Propagation is by seeds sown in spring, by greenwood cuttings in spring, or by layers in autumn.

corállina, Hook. Lvs. cordate, oblong-ovate, coarsely spinulose-dentate, 2–3 in. long: fls. globose, over ½in. long, crimson, in many-fld. bracteate racemes. B.M. 5343. F.S. 20:2137. F.W. 1875:97. G. 2:547. 32:175. H.F. 1863:148. ALFRED REHDER.

BÉRBERIS (Arabic name). *Berberidàceæ.* BARBERRY. Ornamental deciduous or evergreen shrubs, cultivated for their handsome foliage assuming in most species brilliant autumnal tints, and for their bright yellow flowers and attractive fruit.

Spiny shrubs with yellow inner bark and wood: lvs. alternate, often fascicled, usually glabrous, simple, deciduous or evergreen: fls. in elongated or umbel-like, rarely compound racemes, or fascicled or solitary; sepals 6 with 2 or 3 bractlets below; petals 6, often smaller than sepals and usually with 2 glands near the base; stamens 6, included, the anthers opening with valves; ovary superior, 1-celled, with 1 to many ovules: fr. a berry with 1 or several oblong seeds.—Nearly 175 species in Amer. from Brit. Col. to Patagonia, in Asia, Eu., and N. Afr. Monogr. by Schneider in Bull. Hort. Boissier, Ser. II. 5:33, 133, 391, 449, 655, 800, 813 (1905). Mahonia is now considered by most botanists as a distinct genus, differing from the true barberries by the pinnate lvs., by the racemes appearing in the axils of the bud-scales and by the spineless branches. The spines of the barberry are, morphologically, lvs., and the lvs. are borne on short branches in their axils (Fig. 538). The stamens are sensitive; when the filaments are touched with a pin, the fls. first open, and the stamens fly forward upon the pistil. ALFRED REHDER.

The different species of hardy deciduous barberries are excellent decorative shrubs with pleasing habits of growth. The flowers of most of them in spring and early summer, whilst not conspicuous, are very attractive, and the fruits of nearly all are highly ornamental in late summer, fall and early winter on account of their red, dark blue or nearly black color. *Berberis amurensis, B. sinensis, B. diaphana, B. Poiretii, B. Regeliana, B. Sieboldii,* and *B. Thunbergii* all assume brilliant fall colors in varying shades of orange and red. Some species, as *B. Thunbergii, B. Sieboldii,* and *B. Rehderiana,* retain their bright red fruits unchanged until the following spring, while the fruits of the other species shrivel and dry up during the winter.

Berberis aristata is the strongest-growing species and attains a height of 12 to 13 feet in twenty years, with gracefully arching branches, and has violet-red fruits; the thickish leaves are semi-persistent. *B. canadensis* forms a neat compact bush 3 to 3½ feet with upright spreading branches. The small clusters of bright red fruits are very attractive. This is a rare shrub in cultivation, and *B. vulgaris* has often been sold for it. *B. sinensis* is a neat, graceful shrub with pendulous branches 3½ to 4 feet and bears numerous clusters of bright red fruits. *B. diaphana* forms a dense compact shrub 2½ to 3 feet, but its chief decorative value is in its rich fall coloring, as the solitary flowers and fruits

are inconspicuous. *B. Regeliana* has an upright dense habit, and grows from 5 to 6 feet. It has the largest leaves of any of the deciduous species, and the orange-red fruits are remarkably ornamental throughout late summer and fall, until midwinter. This is perhaps the most beautiful barberry in cultivation. *B. Sieboldii* is slow-growing, but is a very choice species. The habit is upright and compact, and the fall coloring is brilliant. The small vermilion-red fruit-clusters are very attractive. *B. vulgaris*, which is commonly grown and has become extensively naturalized, has large clusters of brilliantly colored fruits, and is a most useful shrub in border plantations. It is prolific in many varieties. Perhaps the most distinctive form is the one with yellow fruits, which are usually seedless, or, if the seeds are present, they are abortive. This species makes a good hedge plant as does also *B. amurensis;* for low ornamental hedges, *B. Thunbergii* is excellent. Since it makes a rather broad hedge, the plant is most beautiful when it is not necessary to trim it. *B. Wilsonæ* is a small beautiful shrub, 2 to 2½ feet with slender branches and small leaves. The coral-red fruits are very distinctive. The tips of the branches usually are winterkilled, but the plants recover rapidly in summer.

Few of the evergreen species are dependable in the northeastern states. *B. Sargentiana*, a handsome shrub, attaining a height of about 6 ft., with rather large oblong leaves, has proved quite hardy, and *B. buxifolia, B. stenophylla* and *B. verruculosa* nearly hardy in Massachusetts. *B. Neubertii* rarely has the leaves scorched by winter's cold, but is very slow-growing. For other evergreen species, see *Mahonia* (formerly included in Berberis).

The root and the inner bark of several species are sometimes used for dyeing yellow. Some species have medicinal properties. The fruits of *B. vulgaris* are made into jelly. In wheat-growing districts, planting of Berberis should be avoided, as it is the host of the æcidium stage of *Puccinia graminis*, a fungus which causes the wheat-rust. Destroying the Berberis, however, will not check the propagation of the fungus, as it is able to grow and to spread for years without forming the æcidium stage.

To secure the best results from most of the barberries, they should be planted in moist, light loam, well drained. The deciduous species, however, can be grown in drier situations.

Barberries germinate readily from seeds. The seeds should be separated from the pulp by maceration and sown in "flats" or broadcast in beds in the fall, and they will germinate the following season. The seeds of rare and scarce species should be sown in the greenhouse where they will germinate during the winter. *Berberis Wilsonæ* will germinate in two to three weeks in the greenhouse if sown as soon as ripe. Some of the species cross when grown together, but *B. sinensis, B. Regeliana* and *B. vulgaris* appear to come true. The progeny of *B. Thunbergii* sometimes seem to show that they have been affected by the pollen of *B. vulgaris*.

Most of the barberries can be propagated from the green cuttings of the young wood taken from the first to the middle of June, and placed in sand in a shaded hotbed in precisely the same way as lilacs, viburnums or hydrangeas are treated. This is the best way to perpetuate individuals of strikingly characteristic habits. A very small percentage of the cuttings of the ripe wood placed in the greenhouse in the fall will "strike," but not enough to pay. Some species may be propagated by suckers. Rarer kinds and varieties are sometimes grafted on *B. vulgaris* or *B. Thunbergii*, in August or September under glass, or in early spring in the greenhouse. Grafting, however, is not to be recommended, for the stock usually throws up suckers which are often overlooked on account of the similarity of the foliage of many species; they will overgrow the cion in a short time and smother it. A good plan is to use the purple-leaved barberry as a stock; the suckers are thus easily noticeable and may be removed in time.

JOHN DUNBAR.

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KEY TO THE SPECIES.

A. *Foliage deciduous; lvs. membranous or chartaceous.*
B. *Fls. in elongated racemes or panicles (few-fld. peduncled umbels in No. 7).*
C. *Lvs. dentate or serrate.*
D. *Infl. simple, racemose.*
E. *Branches of last year gray, except those of the purple-lvd. form of No. 1.*
F. *Texture of lvs. rather thin, not distinctly reticulate beneath.*
G. *Shape of lvs. generally obovate; setulose-dentate.* **1. vulgaris**
GG. *Shape of lvs. oblong or elliptic; densely ciliate-dentate.* **2. amurensis**
FF. *Texture of lvs. firmer than in* F, *distinctly reticulate beneath, often obtuse.* **3. Regeliana**
EE. *Branches of last year reddish brown or yellowish brown.*
F. *The lvs. spinulose-dentate.*
G. *Fr. purplish blue, oblong-ovoid, longer than the stout pedicels: racemes longer than the lvs.* **4. aristata**
GG. *Fr. red, short-ovoid, shorter than the slender pedicels.*
H. *Breadth of lvs. ⅛–¾ in., oblong-obovate to obovate, scarcely reticulate.* **5. canadensis**
HH. *Breadth of lvs. ¾–1½ in., usually obovate, reticulate, rounded at the apex.* **6. koreana**
FF. *The lvs. densely setose-ciliate, oblong: racemes umbel-like, 3–6-fld.* **7. Sieboldii**
DD. *Infl. compound, paniculate, 2–6 in. long.*
E. *Branches angled, grayish brown: lvs. rounded at the apex, subcoriaceous.* **8. polyantha**
EE. *Branches nearly terete, brown: lvs. acute, thin.* **9. Francisci-[Ferdinandi**
CC. *Lvs. entire, at least those of the flowering branches.*
D. *Fr. red or purple: lvs. narrow-obovate or oblanceolate, acute or acutish, bright green.*
E. *Bracts at least half as long as the short pedicels: lvs. green beneath, usually narrow-oblanceolate, entire.* **10. Poiretii**

EE. *Bracts much shorter than the elongated pedicels: lvs. grayish or bluish gray beneath, those of the shoots often spinulose, broader*.....11. **sinensis**
DD. *Fr. bluish or purplish black, bloomy: lvs. usually grayish or bluish green, broadly obovate to oblong-obovate.*
E. *Racemes short, usually 5–7-fld.: branches slightly angular: ovules slender-stalked*....12. **heteropoda**
EE. *Racemes many-fld., dense: branches terete: ovules short-stalked*.....13. **integerrima**
BB. *Fls. solitary or sometimes in few-fld. umbels or in dense fascicles (in a variety of No. 14 in 3–10-fld. short racemes).*
C. *Lvs. always entire.*
D. *Young branchlets glabrous: lvs. not reticulate, generally obovate, ½–1½ in. long: fr. scarlet, rather dry*.....14. **Thunbergii**
DD. *Young branchlets puberulous: lvs. reticulate, generally oblanceolate, ¼–1 in. long: fr. salmon-red, juicy*.....15. **Wilsonæ**
CC. *Lvs. partly dentate, partly entire.*
D. *Pedicels ¼in. long: lvs. chalky white beneath, not reticulate, less than 1 in. long: fr. ⅓in. long*.....16. **dictyophylla**
DD. *Pedicels ¾in. long; fls. nodding: lvs. glaucous beneath, reticulate, more than 1 in. long: fr. nearly ½in. long*.....17. **diaphana**
AA. *Foliage persistent or half-evergreen.*
B. *Lvs. entire.*
C. *Shape of lvs. obovate or elliptic: fls. solitary, long-pedicelled*.....18. **buxifolia**
CC. *Shape of lvs. narrow-oblong to linear, revolute at the margin.*
D. *Fls. 1–2, long-pedicelled: lvs. linear*.....19. **empetrifolia**
DD. *Fls. 2–6, in peduncled umbels: lvs. narrow-oblong*.....20. **stenophylla**
BB. *Lvs. dentate.*
C. *Fls. in fascicles or solitary.*
D. *Lower surface of lvs. white or glaucous, ½–1 in. long: fls. 1–2.*
E. *Branchlets angled, smooth*....21. **concinna**
EE. *Branchlets terete, densely verruculose*.....22. **verruculosa**
DD. *Lower surface of lvs. green: fls. several to many.*
E. *Shape of lvs. oblong to narrow-lanceolate, with many teeth.*
F. *Texture of lvs. rather thin; lvs. usually about ½in. broad, indistinctly veined.*
G. *Pedicels slender, ½–1 in. long; fls. 3–8: lvs. with 8–20 teeth on each side: fr. bluish black, bloomy.* 23. **Gagnepainii**
GG. *Pedicels ¼–⅓in. long; fls. many: lvs. with 5–12 teeth on each side: fr. jet-black*.....24. **levis**
FF. *Texture of lvs. thick and firm; lvs. ¾–1¼ in. broad: fls. many; pedicels about ½in. long: fr. black.* 25. **Sargentiana**
EE. *Shape of lvs. roundish to elliptic, with 3–6 teeth: fls. in dense globose clusters*.....26. **hakeoides**
CC. *Fls. in racemes or panicles.*
D. *Branches spiny; young branchlets pubescent or puberulous: lvs. always simple.*
E. *Racemes simple.*
F. *Ovary with long style: lvs. green beneath.*
G. *Branchlets puberulous: lvs. 1–2 in. long: racemes shorter than lvs., 4–10-fld.*.....27. **ilicifolia**
GG. *Branchlets hairy: lvs. ½–1½ in. long: racemes longer than lvs., many-fld.*.....28. **Darwinii**
FF. *Ovary with short style: branchlets puberulous: lvs. whitish beneath, 1–2½ in. long*.....29. **asiatica**
EE. *Racemes compound: lvs. obovate-oblong, with few teeth above the middle or entire, 1–2½ in. long*.....30. **chitria**
DD. *Branches spineless, glabrous: lvs. occasionally 3-foliolate, half-evergreen*.....31. **Neubertii**

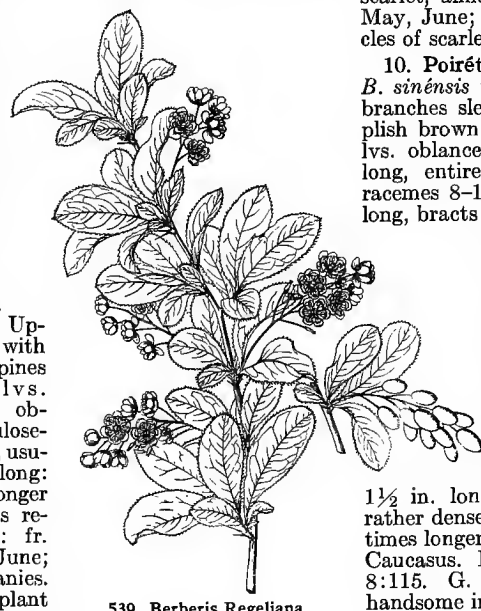
1. **vulgàris,** Linn. Common Barberry. Fig. 538. From 4–8 ft., rarely 15: branches grooved, gray, upright or arching: lvs. oblong-spatulate or obovate, setulose-dentate, pale or grayish green beneath, membranous, 1–2 in. long: racemes pendulous, many-fld.; fls. bright yellow: fr. oblong-ovoid, scarlet, finally purple. May, June: fr. Sept., Oct. Eu. to E. Asia; escaped from culture and naturalized in E. N. Amer. Gn. 35:264.—Handsome in spring, with its golden yellow fls. and light green foliage; and in fall, with its bright scarlet frs., remaining through the whole winter. A very variable species. Of the many garden forms, the most effective is var. **atropurpùrea,** Regel (var. *purpùrea,* Hort., not Loud., which is a form with purple fr.), with purple-colored lvs. (Gt. 9:278, 1); little different is var. **macrophýlla,** Kew Bull. (*B. vulgàris fòliis purpùrea macrophýlla,* Paul & Sons), with larger lvs. of deep purple color. Other varieties are: Var. **álbo-variegàta,** Zabel, lvs. variegated with white, rather small; Var. **aùreo-marginàta,** Zabel, lvs. with yellow margin, rather large; var. **álba,** Don (var. *leucocárpa,* Hort.), white-fruited; var. **aspérma,** Don (var. *apýrena,* Hort.), seedless; var. **dúlcis,** Loud. (var. *edùlis,* Hort.), less acid; var. **lùtea,** Don (var. *xanthocárpa,* Hort.), yellow-fruited; var. **macrocàrpa,** Jaeger, with larger fr. The forms with black or purplish blue fr., as var. *nìgra,* Don, and var. *violàcea,* Don, do not belong here, but are either hybrids or belong to other species.

538. Berberis vulgaris. (×½). Showing the spines and foliage.

2. **amurénsis,** Rupr. (*B. vulgàris* var. *amurénsis,* Regel). Three to 8 ft.: branches straight, gray, upright, grooved: lvs. cuneate, oblong or elliptic, densely ciliate-dentate, slightly reticulate and bright green and lustrous beneath, 1–3 in. long: racemes upright or nodding, 6–12-fld., about as long as lvs.: fr. oblong-ovoid, scarlet. May: fr. Sept. Manchuria, N. China. Gng. 5:119. G. W. 7, p. 413. See page 3566.

3. **Regeliàna,** Koehne (*B. vulgàris* var. *japónica,* Regel. *B. amurénsis* var. *japónica,* Rehd. *B. japónica,* Schneid., not DC. *B. Sieboldii,* Hort., not Miq. *B. Hakodàte,* Hort.). Fig. 539. Upright shrub, to 6 ft.: branches gray, grooved: lvs. elliptic-oblong and acute, or obovate or obovate-oblong and obtuse, 1–2½ in. long, setulose-dentate, often rather densely so, pale or grayish green and distinctly reticulate beneath, of firm texture: racemes upright or nodding, 6–12-fld., shorter or about as long as lvs.: fr. oblong-ovoid, scarlet, with slight bloom. May, June: fr. Sept., Oct. Japan. G.F. 3:249 (adapted in Fig. 539). A.G. 18:454.

4. **aristàta,** DC. (*B. coriària,* Royle. *B. floribúnda,* Wall.). Shrub, to 8 ft.: last year's branches yellowish brown, slightly angular; spines mostly simple: lvs. elliptic to ovate-oblong, acute or obtusish, spinosely dentate, occasionally entire, 1–2½ in. long, of firm texture at maturity: racemes 10–25-fld., sessile, usually spreading and stout: fr. nearly ½in. long, longer than the stout pedicels, bright red, finally bluish purple and bloomy; stigma on a short distinct style. June; fr. Sept., Oct. Himalayas. B. R. 27:46.—Hardy at the Arnold Arboretum. Hybrids occur with *B. vulgaris.*



539. Berberis Regeliana. (×⅓)

5. **canadénsis,** Mill. (*B. caroliniàna,* Loud. *B. angùlizans,* Hort.). Upright shrub, 1–3 ft., with arching branches: spines small, 3-parted: lvs. cuneate-oblong to obovate, remotely spinulose-dentate, rarely entire, usually obtusish, 1–2 in. long: racemes many-fld., longer than the lvs.; petals retuse or emarginate: fr. ovoid, scarlet. May, June; fr. Sept., Oct. Alleghanies. G.W. 1:101.—The plant sold under this name is usually *B. vulgaris.* Lower and more graceful then *B. vulgaris;* the foliage turns scarlet in autumn.

6. **koreàna,** Palibin. Shrub, to 6 ft.: branches grooved, yellowish or reddish brown; spines short, scarcely ¼in. long, usually simple: lvs. obovate, or oval, rounded at the apex, cuneate at the base, 1–2½ in. long and ½–1½ in. broad, spinose-serrulate, reticulate and pale beneath: racemes shorter than lvs., rather dense, slender-stalked, nodding: fr. subglobose-ovoid, ¼in. long, bright red. May: fr. Sept., Oct. Korea. J.C.T. 26, 1:5.—Handsome species with broad lvs. coloring deep red in autumn and with bright red fr. persisting until the following spring; has proved perfectly hardy at the Arnold Arboretum.

7. **Siebòldii,** Miq. Shrub, to 3 ft.: last year's branches deep reddish brown, angular, 2-edged toward the end: spines 3-parted, slender: lvs. oblong-obovate, 1–2½ in. long, acute or obtusish, cuneate at the base, setosely ciliate and usually revolute at the margin, bright green below: racemes 3–6-fld., slender-peduncled, umbel-like: fr. ovoid to subglobose, ¼in. long, rather dry, bright red and lustrous. May, June: fr. Sept. Japan. S.T.S. 1:14.—A very handsome shrub: lvs. purplish when unfolding and marked with green veins, deep vinous red in autumn: the fr. retains the bright color until the following spring. It has proved perfectly hardy at the Arnold Arboretum. Often *B. Regeliana* is cultivated under the name *B. Sieboldii.*

8. **polyántha,** Hemsl. Shrub, to 12 ft.: branches grayish brown, slightly angled, glabrous or puberulous with usually short spines: lvs. cuneate-obovate, rounded at the apex, leathery, spiny-serrate, rarely nearly entire, pale grayish green, ¾–1¼ in. long: fls. deep yellow in pendulous short-stalked panicles 2–6 in. long: fr. oblong-ovoid, narrowed into a distinct style, pale red, bloomy, ⅓in. long. June, July; fr. Sept. W. China. G. 33: 269.—Very handsome with its large panicles of deep yellow fls.; not quite hardy in Mass.

9. **Francísci-Ferdinándi,** Schneid. Shrub, to 10 ft.: branches red-brown, nearly terete, with long spines: lvs. elliptic to ovate-lanceolate, acute, cuneate at the base, densely spiny-serrate, bright green, thin, 1–2½ in. long: fls. yellow in pendulous, usually narrow panicles, with the slender stalk 3–5 in. long: fr. ovoid-oblong, scarlet, almost ½in. long, with nearly sessile stigma. May, June; fr. Sept. W. China.—The drooping panicles of scarlet frs. are very handsome.

10. **Poirétii,** Schneid. (*B. sinénsis,* Hemsl., not Poir. *B. sinénsis* var. *angustifòlia,* Regel). Shrub, to 5 ft.: branches slender, arching, the younger grooved, purplish brown; spines about ⅓in. long, usually simple: lvs. oblanceolate, to narrow-oblanceolate, ½–1½ in. long, entire, slightly reticulate and green beneath: racemes 8–14-fld., 1–2 in. long; pedicels scarcely ¼in. long, bracts about half as long: fr. ovoid-oblong, deep blood-red. N. China, Amurland.—Hardy and handsome, but rare in cult. and usually confounded with the following species.

11. **sinénsis,** Poir. (*B. spathulàta,* Schrad. *B. ibèrica,* Stev. & Fisch. *B. sanguinolénta,* Schrad. *B. Guímpelii,* Koch). From 4–6 ft., with slender, often arching branches, the younger grooved, reddish brown; spines 1–3-parted, ½–¾in. long: lvs. cuneate, oblong or obovate-lanceolate, entire or sometimes with a few teeth, grayish green or glaucescent beneath, ½–1½ in. long: racemes pendulous, slender-peduncled, rather dense; pedicels slender, about ½in. long, several times longer than the bracts: berries ovoid, purplish. Caucasus. B.M. 6573. G.O.H. 63. L.D. 7:487. G.W. 8:115. G. 34:379.—A hardy, graceful species, very handsome in fr.

12. **heterópoda,** Schrenk. Fig. 540. Three to 6 ft.: branches stout, spreading, the younger chestnut-brown, lustrous slightly grooved, spines sometimes to 2 in. long, often wanting: lvs. broadly obovate or oval, entire or sometimes remotely serrate, pale bluish green, 1–2 in. long, some short and some slender-petioled: fls. in stalked, usually 5–7-fld. racemes, orange-yellow, fragrant; ovules long-stalked: fr. ovoid, dark blue with glaucous bloom. May. Turkestan, Songaria. G.F. 8:455 (adapted in Fig. 540).—Handsome and very distinct species. *B. heteropoda* var. *oblonga,* Regel, see *B. oblonga* in supplementary list.

13. **integérrima,** Bunge (*B. nummulària,* Bunge). Shrub, to 6 ft.: last year's branches terete, purplish brown; spines usually simple, to 2 in. long: lvs. obovate or broadly obovate, usually entire, sometimes remotely setose-serrate, grayish green: racemes dense, usually many-fld.; fls. small, on short pedicels, about ⅛-in. long; ovules short-stalked: fr. black, globose-ovoid. May.—A variable species similar to the preceding.

14. **Thúnbergii,** DC. Figs. 541, 542. Dense, low shrub, 2–5 ft.: branches spreading, deeply grooved, brown, with simple spines: lvs. obovate or spatulate, quite entire, glaucescent beneath, ½–1½ in. long: fls. 1–3, pale yellow: fr. elliptic or nearly globose, bright red. Apr., May. G.F. 2:53. B.M. 6646. R.H. 1894: 173. A.G. 18:357. Gng. 4:241; 5:119, 353, 355. Mn. 2:118. A.F. 8:526.—One of the most valuable species, especially remarkable for its low, dense, horizontal growth, its large brilliant red frs., remaining fresh till the following spring, and for its bright scarlet fall coloring; hardy. Very valuable for borders of walks and drives and for low ornamental hedges. Endures partial shade. Cattle and sheep do not browse it much. Var. **Maximòwiczii,** Franch. & Sav., has the lvs. green beneath. Var. **pluriflòra,** Koehne, has 3–10 fls. in short, umbel-like raceme. Var. **mìnor,** Rehd. (var. *Dáwsonii,* Bean). Very low, dense shrub, ½–2 ft. high, with small lvs. about ½in. long. A variety with the lvs. variegated with white is var. Silver Beauty, which originated in

Franklin, Mass. G.C. III. 49:10. Hybrids with *B. vulgaris* occur.

15. **Wilsonæ,** Hemsl. Low shrub with spreading branches: last year's branches reddish brown, angular, puberulous; spines 3-parted, slender, ½–¾in. long: lvs. oblanceolate or narrowly obovate, ¼–1 in. long, rounded and mucronate or acutish at the apex, rarely 3-pointed, pale green and dull above, glaucous beneath, reticulate, thickish: fls. golden yellow, in dense clusters or in very short-stalked umbels: fr. globose, ¼in. diam., salmon-red, usually yellow or whitish on the shady side. May; fr. in Sept. W. China. B.M. 8414. G.C. III. 42:372. Gn. 71, p. 541. G. 29:520. J.H. III. 55:425.—Very distinct handsome shrub, with small foliage, assuming a brilliant fall coloring. It has proved hardy at the Arnold Arboretum in somewhat sheltered positions.

16. **dictyophýlla,** Franch. Shrub, to 6 ft. high, with slightly angular branches, usually covered with white bloom while young, reddish brown the second year: lvs. obovate to oblong-obovate, ½–1 in. long, obtuse or acutish, entire or spinose-dentate, chalky white beneath: fls. solitary, pale yellow, ½–¾in. diam., short-stalked: fr. red, ovoid, ⅓in. long. May. S. W. China.—Very distinct, with its small foliage white beneath like the young shoots. Var. **albicaûlis,** Hort., is a form with the young branchlets distinctly bloomy and the lvs. intensely white beneath. Var. **epruinôsa,** Schneid. Branchlets angled, red-brown, not bloomy: lvs. light green beneath. Var. **approximàta,** Rehd. (*B. approximàta,* Sprague). Lvs. obovate, spinose-dentate, rarely entire, fls. smaller. B.M. 7833; the type of the species with all or nearly all lvs. entire is figured in Franchet, Plant. Delavay. 11.

17. **diáphana,** Maxim. (*B. yunnanénsis,* Hutchins., not Franch.). Shrub, to 3 ft., with rather stout branches, grooved, light yellowish brown in their second year; spines 1–3-parted, ¼–½, rarely to 1½ in. long: lvs. obovate to oblong-obovate, obtusish, ¾–1½ in. long, spinose-serrulate or sometimes entire, glaucous and reticulate beneath: fls. bright yellow, ½in. diam., solitary, or in 2's or 3's on a common peduncle; pedicels ¾-in. long: fr. oblong, often attenuated at the apex, scarlet, slightly bloomy, nearly ½in. long. May; fr. in Sept. W. China. B.M. 8224. S.T.S. 2:109.—Remarkable for its large fr.; the lvs. turn scarlet in autumn. Hardy at the Arnold Arboretum.

18. **buxifòlia,** Poir. (*B. dúlcis,* Sweet). One to 3 ft.: branches brown, grooved; spines usually 3-parted, short: lvs. cuneate, obovate or elliptic, ⅓–1 in. long: fls. solitary, on long pedicels, orange-yellow: fr. nearly globose, blackish purple. May. Chile to Strait of Magellan. B.M. 6505. S.B.F.G. II. 1:100. P.M. 10:171. L.B.C. 20:1941. H.F. 1857:122.—A very graceful, free-flowering shrub; one of the hardiest of the evergreen species; will stand the winter even N. if somewhat protected.

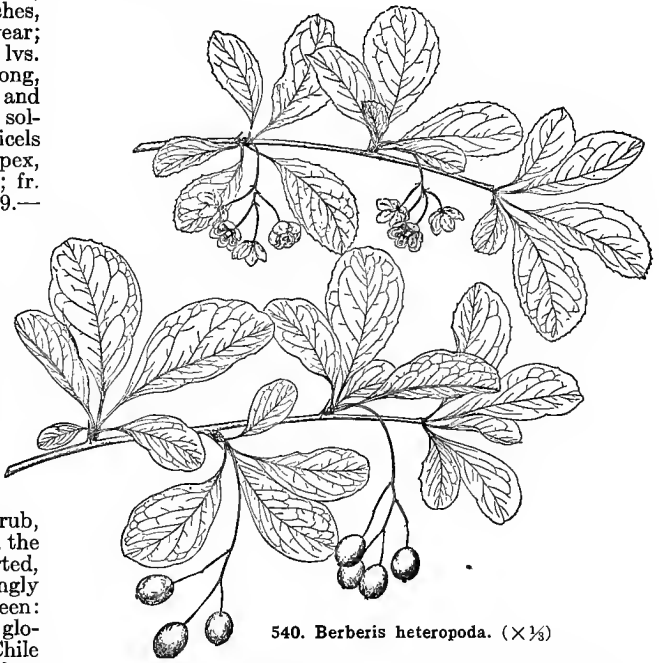
19. **empetrifòlia,** Lam. Low, densely branched shrub, to 2 ft.: last year's branches slightly angular, brown, the young ones purplish, often bloomy; spines 1–3-parted, ¼–¾in. long: lvs. linear, ¼–¾in. long, strongly revolute at the margin, spiny pointed, bright green: fls. 1–2, on slender pedicels, about ¼in. long: fr. globose, bluish black, about ¼in. diam. May, June. Chile to Patagonia. B.R. 26:27. S.B.F.G. 4:350.—Less often cult. and not so handsome as the following hybrid, which has larger lvs. and umbellate fls.

20. **stenophýlla,** Mast. (*B. Dárwinii* × *B. empetrifòlia*). Height 1–3 ft., with slender, arching branches: lvs. narrow-oblong, revolute at the margins, spiny pointed, ½–1¼ in. long, dark green above: fls. 2–6, in peduncled nodding umbels. Of garden origin. May. G.C. III. 7:619. A.F. 6:325. Gn. 14, p. 46; 61, p. 305 (habit); 69, p. 318. G.W. 14, p. 593; 15, p. 103.—Handsome shrub, hardy in sheltered positions at the Arnold Arboretum.

21. **concínna,** Hook. f. Low, spreading shrub, to 3 ft.: branches of last year pale brown, angular; spines 3-parted, slender: lvs. obovate, ½–1 in. long, rather thin and only half-evergreen, remotely spinose-dentate, bright green above, glaucous beneath: fls. solitary or in 2's on slender stalks, ¾–1 in. long, bright yellow, over ½in. across: fr. red, oblong-ovoid. June. Himalayas. B.M. 4744.—One of the most graceful barberries, similiar to *B. dictyophylla,* but easily distinguished by the slender-stalked fls. and half-evergreen lvs. It has proved hardy at the Arnold Arboretum in sheltered positions.

22. **verruculòsa,** Hemsl. & Wilson. Dwarf, spreading shrub, to 3 ft., evergreen: branches terete, densely verruculose, with slender spines often as long as lvs.: lvs. ovate or elliptic to ovate-lanceolate, remotely spiny-toothed, dark green and lustrous above, glaucous beneath, ½–1 in. long: fls. 1–2, ½in. across: fr. violet-black, bloomy, ovoid ⅓in. long, with sessile stigma. June; fr. Oct. W. China. B.M. 8454.—Very handsome with its dense dark green and lustrous foliage. Has proved hardy at the Arnold Arboretum.

23. **Gagnepaînii,** Schneid. Evergreen shrub, to 6 ft.: branches yellowish gray, terete, with slender, rather long spines: lvs. narrow-lanceolate, spiny-serrate, revolute at the margin, light green beneath, indistinctly veined, 1½–3½ in. long: fls. fascicled, 3–8, ½in. across; pedicels ½–1 in. long: fr. ovoid, about ⅓in. long, bluish black, bloomy, with nearly sessile style. June; fr. Oct. W. China. G.C. III. 46:226. B.M. 8185 (as *B. acuminata*).

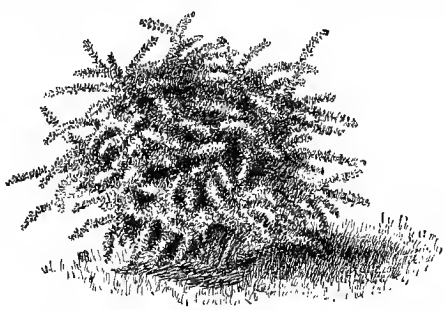


540. Berberis heteropoda. (×⅓)

24. **lèvis,** Franch. Shrub, to 5 ft., evergreen: branches light yellowish gray, angled, usually with long spines: lvs. narrow-lanceolate, remotely spiny-serrate, slightly or not revolute at the margin, light green beneath, indistinctly veined, 1–2 in. long: fls. in many-fld. fascicles, ⅓in. across; pedicels short, ¼–½in. long: fr. short-ovoid, about ¼in. long, black; stigma on a short style. June; fr. Oct. W. China. See discussion on page 3566.

25. **Sargentiàna,** Schneid. Evergreen shrub, to 6 ft.: branches nearly terete, grayish brown, with usually short spines: lvs. coriaceous, elliptic-oblong to oblong-lanceolate, acute or acuminate, densely spiny-serrate, dark green above, light green and reticulate below, 1½–4 in. long: fls. fascicled, many, ½in. across; pedicels ½–¾in. long: fr. globose-ovoid, ⅓in. long, black, with sessile stigma. May, June; fr. Sept., Oct. W. China. —Very handsome with large dark green lvs. At the Arnold Arboretum it has proved the hardiest of the evergreen barberries. See page 3566.

26. **hakeoïdes,** Schneid. (*B. congestiflòra* var. *hakeoìdes*, Hook. f. *B. congestiflòra*, Hort., not Gay). Shrub, to 6 ft.: last year's branches angular, grayish brown; spines small or oftener leafy., and semi-orbicular with



541. Berberis Thunbergii.

spiny teeth: lvs. oval to nearly orbicular, 1–2 in. long, rigid, spinose-dentate, bright green above, glaucous beneath: fls. in dense globose clusters; clusters very numerous along the branches and forming spikes toward the end which is often leafless: fr. ovoid, ¼in., bluish black. Chile. G.C. III. 29:295. B.M. 6770.—Very handsome with its numerous bright yellow fl.-clusters. Not hardy N.

27. **ilicifòlia,** Forst. Shrub, to 8 ft.: last year's branches angular, purplish, minutely pubescent when young: lvs. obovate, ¾–2 in. long, dark green above, coarsely spiny-toothed: racemes 5–10-fld., shorter than the lvs. with the peduncle about 1 in. long; fls. orange-yellow. Patagonia. B.M. 4308. F.S. 3:291.—Similar to the following. Very rare in cult.; for the plants usually cult. under this name see No. 31.

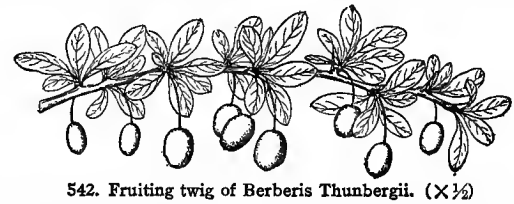
28. **Dàrwinii,** Hook. Shrub, 1–3 ft.: branches brown, pubescent when young: lvs. cuneate, obovate, spiny-toothed and usually 3-pointed at the apex, glossy dark green above, light green and lustrous beneath, ½–1 in. long: racemes 6–20-fld., longer than the lvs., with the peduncle 2–4 in. long, pendulous; fls. orange-yellow, often reddish outside; style as long as the ovary: fr. dark purple. June; fr. Aug., Sept. Chile to Patagonia. B.M. 4590. F.S. 7:663. P.F.G. 2:46. J.F. 2:111. G.M. 44:660.

29. **asiática,** Roxbg. (*B. hypoleùca*, Lindl.). Shrub, to 10 ft.: last year's branches grayish yellow, grooved, puberulous when young; spines small: lvs. obovate to oblong, 1–3 in. long, entire or with few teeth, whitish beneath: racemes 8–25-fld., 1–2 in. long: fr. purple, with distinct style. Apr.. May. Himalayas. J.H.S. 2:246.—Hardy only S.

30. **chìtria,** Lindl. (*B. arìstata*, Sims, not DC.). Shrub, to 6 ft.: last year's branches yellowish or reddish brown, slightly grooved or nearly terete; spines slender, to ¾in. long: lvs. oblong, or oblong-obovate, cuneate at the base, 1–3 in. long, spinose-serrate or entire, subcoriaceous: fls. deep yellow, often reddish, in long-peduncled panicles: fr. purplish, ovoid-oblong, with distinct style. June, July. Himalayas. B.R. 9:729. B.M. 2549 (a few-fld. form, as *B. umbellata*).—Often confused with *B. aristata*, which is easily distinguished by its simple sessile racemes.

31. **Neubèrtii,** Lem. (*B. vulgàris* × *Mahonia Aquifòlium*). Branches grayish brown, without spines, upright: lvs. simple, oval or ovate, or sometimes oblong, cuneate at the base, often with 1 or 2 smaller lateral lfts., spiny-toothed, dark grayish green above, 1½–3 in. long: fls. in racemes. Of garden origin. I.H. 1:111. G.C. III. 9:73, 75. Var. **latifòlia,** Rehd. (*B. ilicifòlia*, Hort., not Forst. *B. latifòlia*, Hort.). Lvs. broader, those of the shoots more rigid, with fewer and broader, more spreading spines, with broader often nearly truncate base.—Hardy in sheltered positions at the Arnold Arboretum, but not evergreen; in the S. the lvs. are persistent.

B. actinacántha, Mart. Evergreen shrub, to 3 ft.: spines 4-7-parted: lvs. obovate to oblong, ½–1 in. long, spiny: fls. slender-stalked, in clusters. Chile. B.R. 31:55.—*B. acuminàta*, Franch. Allied to B. Gagnepainii. Evergreen shrub: branches yellow, terete: lvs. lanceolate, 4–7 in. long, acuminate, with numerous small spiny teeth: fls. fascicled; pedicels about 1 in. long. S.W. China. J.H.F. 1900:191.—*B. acuminàta*, Stapf=B. Gagnepainii.—*B. acuminàta*, Veitch=B. Veitchii.—*B. aetnénsis*, Presl. Low, dense, deciduous shrub: branches yellowish gray, angular with numerous spines, about ½in. long: lvs. oblanceolate or obovate, spinose-serrate, ½–1½ in. long: racemes short, 8–14-fld. Sicily, Sardinia, Corsica.—*B. aggregàta*, Schneid. Allied to B. polyantha. Lvs. oblong-obovate, spiny-toothed, ¾–1 in. long: panicles short and very dense, about ¾in. long: fr. subglobose, salmon-red. W. China.—*B. Andreàna*, Naudin=B. laurina.—*B. angulòsa*, Wall. Deciduous shrub, to 4 ft.: young branchlets puberulous, angular, spiny: lvs. oblong-obovate, ½–1½ in. long, whitish beneath, entire or sparsely spinulose: fls. solitary or few, slender-stalked: fr. red. Himalayas. B.M. 7071.—*B. Aquifòlium*, Pursh=Mahonia Aquifolium.—*B. argùta*, Ball=Mahonia arguta.—*B. Belstaniàna*, Hort.=B. virescena.—*B. Bergmánniæ*, Schneid. Allied to B. Sargentiana. Evergreen shrub, to 6 ft.: lvs. coriaceous, elliptic, indistinctly veined, 1–1½ in. long: fls. fascicled, many: fr. oblong-ovoid, black, bloomy. Cent. and W. China. Var. *acanthophýlla*, Schneid. Lvs. to 2 in. long, sinuately spiny. W. China. Only the variety is in cult.—*B. Bretschneideri*, Rehd. Allied to B. koreana. Shrub, to 8 ft.: branchea terete, reddish brown with few and small spines: lvs. obovate-oblong, 1½–2½ in. long, setose-serrate: racemes about 1½ in. long: fr. oblong, purplish. N. China. S.T.S. 2:110. Hardy N.—*B. brachýpoda*, Maxim. Allied to B. amurensis. Shrub, to 6 ft.: lvs. elliptic-oblong, acute, pubescent on both sides, 1½–3½ in. long: racemes pubescent, slender, 2–3 in. long: fr. scarlet. Cent. China.—*B. candidula*, Schneid. (B. Wallichiana var. candidula, Schneid. B. Wallichiana var. pallida, Boiss.). Allied to B. verruculosa. Evergreen prostrate shrub: branchlets glabrous, yellowish: lvs. elliptic with few spiny teeth, white beneath, about 1 in. long: fls. solitary. Cent. China. V.F. 15. —*B. Càroli*, Schneid. (B. integerrima var. stenophylla, Maxim.). Similar to B. Poiretii. Shrub, to 6 ft.: lvs. oblanceolate, usually entire, ¾–1½ in. long: racemes 8–14-fld. Mongolia. Var. *hoanghénsis*, Schneid. Racemes many-fld., 1–1½ in. long, pedicels ⅛in. long: fr. subglobose, salmon-red. W. China. Only the variety is in cult.—*B. cerásina*, Schrad. Allied to B. sinensia, but lvs. more often toothed, racemes shorter, hardly longer than the lvs. and spines shorter, usually simple. Of unknown origin.—*B. congestiflòra*, Gay. Allied to B. hakeoides. Lvs. oblong-ovate to orbicular, often entire: fls. in dense umbels on upright stalks ½–1 in. long. Chile.—*B. cratægina*, DC. Shrub, to 5 ft.: branches brownish red, nearly terete: lvs. deciduous, oblanceolate to oblong-obovate, ½–1½ in. long, uaually entire: racemes 6–20-fld., 1–2 in. long: fr. bluish black. Asia Minor.—The true B. cratægina does not seem to be in cult.—*B. crética*, Linn. Deciduous shrub, to 3 ft.: branches purplish with



542. Fruiting twig of Berberis Thunbergii. (×½)

numerous spines often nearly 1 in. long: lvs. lanceolate, ½–¾in. long, usually entire: fls. 3–7, in short umbel-like racemes. S.E. Eu. Orient.—*B. crispa*, Gay. Allied to B. hakeoidea. Branches puberulous: lvs. thinner, ovate or oval, spiny-toothed, ½–1½ in. long: fls. 5–8, on slender pedicels, clustered. Chile.—*B. dealbàta*, Lindl. Lvs. persistent, nearly orbicular, with few spiny teeth: racemes short, dense, nodding. Mex. B.R. 21:1750.—*B. élegans*, Hort.=B. Lycium.—*B. emarginàta*, Willd. Possibly B. sibirica×vulgaris. Low shrub: spines 1–5-parted: lva. obovate to obovate-oblong, ½–1¾ in. long, setulose-dentate: racemes shorter than the lvs., upright; petals uaually emarginate. Of unknown origin. G.O.H. 62.—*B. Féndleri*, Gray. Allied to B. canadensis. Shrub, to 5 ft.: spines 3–5-parted: lvs. obovate-lanceolate, ¾–1¾ in. long, lustrous, entire or spinulose: racemes dense, long-peduncled, pendulous. Colo. to New Mex. G.F. 1:462.—*B. Fórtunei*, Lindl.=Mahonia Fortunei.

—*B. Frémóntii*, Torr.=Mahonia Fremontii.—*B. glaùca*, Benth., not Kunth=B. Jamiesonii.—*B. grácilis*, Hartw.=Mahonia gracilis. —*B. hæmatocárpa*, Wooton=Mahonia hæmatocarpa.—*B. heterophýlla*, Juss. Allied to B. ilicifolia. Branches glabrous, yellowish brown; spines 3–5-parted: lvs. persistent, obovate to oblong, ½–1¼ in. long, entire, or with 2–4 spiny teeth: fls. solitary: fr. purplish black. Straits of Magellan. H.E. 1:14.—*B. heterophýlla*, Zabel= Mahonia heterophylla.—*B. Hoòkeri*, Lem. (B. Jamiesonii, Hort., not Lindl. B. Wallichiana, Hook., not. DC.). Allied to B. Sargentiana. Branchlets angular, stout, pale yellowish brown: lvs. elliptic-oblong to oblong-lanceolate, sinuately spiny-toothed, 1–2 in. long: fls. 3–6; pedicels slender: fr. oblong, large, with 4–8 seeds. Origin uncertain; probably Himalayas. I.H. 6:207. B.M. 4656.—*B. Hutchinsònii*, Rehd.=Mahonia arguta.—*B. Jamiesònii*, Lindl. (B. glauca, Benth., not Kunth). Evergreen shrub: branches terete, brownish red: lvs. oblong, 2–3 in. long, entire or with few teeth, lustrous, pale green beneath: fls. in close panicles; pedicels ½in. long. Peru.—Often confused with B. Hookeri and B. Verschaffeltii.—*B. japónica*, Spreng.=Mahonia japonica.—*B. Knìghtii*, Hort.=B. Wallichiana var. latifolia.—*B. laurina*, Billbg. (B. Andreana, Naudin). Allied to B. buxifolia. Shrub, to 5 ft.: branches glabrous, terete; spines to 1 in. long: lvs. oblanceolate, 1–3 in. long, entire, pale beneath: racemes pendulous, to 5 in. long: fr. black, bloomy. S. Brazil. R.H. 1899, p. 9.—*B. laxiflòra*, Schrad. Allied to B. amurensis. Lvs. oval to ovalelliptic, obtuse, serration less dense, grayish green beneath: racemes pendulous, 2–3½ in. long. Of unknown origin.—*B. Liechtensteinii*, Schneid. Deciduous shrub, to 5 ft.: branches slightly angled, purplish with strong spines: lvs. ovate to lanceolate, sinuately spiny, light green beneath, ½–2 in. long: fls. in racemes 1–1½ in. long: fr. globose, red, with 2 seeds. W. China.—*B. loxénsis*, Benth. Lvs. persistent, oblong-obovate, entire or sometimes with a few spiny teeth, lustrous: fls. small in peduncled, loose racemes. Peru. F.S. 6, p. 69.—*B. lùcida*, Schrad. Allied to B. vulgaris. Lvs. elliptic to elliptic-oblong, dark green and lustrous above, obtuse, remotely and finely serrate: racemes spreading, about 2 in. long: fr. red. Of unknown origin; possibly variety of B. vulgaris.—*B. Lỳcium*, Royle (B. ruscifolia, Hort., not Lam. B. elegans, Hort.). Shrub, to 6 ft. or more: branches terete, yellowish gray: lvs. sub-persistent, obovate-lanceolate, ¾–2 in. long, entire or spinulose: racemes sessile, longer than the lvs., drooping: fr. violet. Himalayas. B.M. 7075.—*B. macrophýlla*, Hort.=B. Wallichiana var. latifolia.—*B. macracànthа*, Schrad. Possibly B. aristata×vulgaris. Branches yellowish gray: lvs. elliptic, acutish, remotely spiny-toothed, 1–2 in. long: racemes nodding, 1½–2½ in. long: fr. red. Of unknown origin.—*B. microphýlla* var. *serràta*, Hort.=B. serrata.—*B. Mouillacàna*, Schneid. Deciduous shrub, to 10 ft.: branches grooved, purplish, with simple spines: lvs. obovate-lanceolate, obtuse, usually entire, light green beneath, ½–2 in. long: fls. in racemes, to 1½ in. long: fr. scarlet, with 2 seeds. W. China.—*B. oblónga*, Schneid. (B. heteropoda var. oblonga, Regel.). Allied to B. heteropoda. Branches angular: lvs. obovate: racemes 10–20-fld., usually compound near the base; ovary with 2 sessile ovules: fr. oblong. Turkestan.—*B. nepalénsis*, Spreng. =Mahonia nepalensis.—*B. nervòsa*, Pursh=Mahonia nervosa.— *B. pállida*, Benth.=Mahonia pallida.—*B. parviflòra*, Lindl.=B. ruscifolia.—*B. parvifòlia*, Sprague. Allied to B. Wilsonæ. Low shrub: lvs. half-evergreen, oblanceolate, entire or occasionally spiny-toothed, glabrous and reticulate beneath: fls. fascicled, 3–6: fr. globose, terra-cotta color. W. China.—*B. pinnàta*, Lag.=Mahonia pinnata.—*B. Prátti*, Schneid. Allied to B. polyantha. Shrub, to 10 ft.: lvs. oblong-obovate, entire or with few spiny teeth, reticulate, thinner: panicles narrow, to 6 in. long: fr. globose, salmon-red. W. China. Var. *recurvàta*, Schneid. Raceme narrow, spike-like: fr. on reflexed pedicels. W. China.—*B. pruinòsa*, Franch. Evergreen shrub: branches brownish yellow, nearly terete; spines to 1 in. long: lvs. ovate-oblong, ¾–2 in. long, strongly spiny-toothed, whitish beneath: fls. 8–25, fascicled, rarely in a peduncled umbel: fr. bluish black. S.W. China.—*B. Rehderiàna*, Schneid. Allied to B. koreana, but much smaller in every part, branches reddish brown, slightly angled; spines 3–5-parted: lvs. obovate to oblong, spinose-aerrate, ¾–1¼ in. long: fls. 8–15, in a peduncled raceme: fr. subglobose, bright red. Origin unknown.—Hardy, graceful shrub; the fr. remains unchanged until the following spring.—*B. rèpens*, Lindl. =Mahonia repens.—*B. rotundifòlia*, Hort.=Mahonia repens var. rotundifolia.—*B. ruscifòlia*, Lam. (B. parviflora, Lindl.). Allied to B. buxifolia. Branches terete, yellowish gray: lvs. oblong, entire or with a few coarse teeth, ½–1½ in. long: fls. in a 4–5-fld. peduncled raceme: fr. bluish black. Argentine. J.H.S. 2:243.—*B. ruscifòlia*, Hort.=B. Lycium.—*B. sanguínea*, Franch. Allied to B. Gagnepainii. Lvs. narrow-lanceolate, ¾–2 in. long, spinose-serrate, pale beneath: fls. with red sepals, in fascicles of 2–4; pedicels ¾in. long: fr. bluish black. W. China. V.F. 16.—*B. seròtina*, Lange. Allied to B. sinensis. Lvs. light green, oblanceolate, usually entire: racemes short and dense. Origin unknown.—*B. serràta*, Koehne (B. microphylla var. serrata, Hort.). Low, deciduous shrub: branches grooved, reddish or yellowish brown: lvs. oblong-lanceolate, ½–1 in. long, spinulose-serrate: racemes dense, short. Origin unknown.— *B. sibírica*, Pall. Deciduous shrub: branches angular, yellowish brown; spines 3–9-parted: lvs. obovate, remotely toothed: fls. solitary or 2, short-pedicelled: fr. red. Siberia. B.R. 6:487.—*B. Silva-Taroucàna*, Schneid. Deciduous shrub, to 10 ft.: branches grooved, brown; spines small or wanting: lvs. oblong-lanceolate or obovate-oblong, obtuse, entire or with few small teeth, pruinose beneath, ½–2 in. long: racemes 1–2½ in. long; pedicels ⅓–¾in. long: fr. globose-ovoid, scarlet, with 1–2 seeds. W. China.—*B. subcaudulàta*, Schneid. Deciduous shrub: branches strongly angulate: lvs. oblanceolate, ½–1 in. long, acute, rarely 3-pointed at the apex, whitish beneath: fls. in very short, 6–8-fld. racemes or rarely fascicled, nodding: fr. globose, red. W. China.—*B. tenuifòlia*, Lindl.=Mahonia tenuifolia.—*B. thibética*, Schneid. Deciduous shrub: branches angular, purplish, bloomy: lvs. obovate-lanceolate, ½–1 in. long, rounded or acutish, mucronulate, entire, whitish beneath: fls. in 1–5-fld. fascicles; pedicels about ⅛in. long. W. China.—*B. Tischleri*, Schneid. Allied to B. diaphana. Shrub, to 8 ft.: branches angled, gray, spiny: lvs. obovate to oblong, obtuse, spinulose-serrate, pruinose beneath, ½–1¾ in.: racemes 4–15-fld.; pedicels ½–1 in. long: fr. oblong, with a distinct style, pale red, pruinose. W. China.—*B. toluacénsis*, Hort.=Mahonia heterophylla.—*B. triacanthóphora*, Fedde. Allied to B. Gagnepainii: evergreen shrub, to 5 ft.: branches terete, brown: lvs. linear-lanceolate with 2 to 5 spiny teeth on each side or entire, glaucescent beneath, 1–2 in.: fls. 2–5, slender-stalked: fr. black, ovoid, with sessile style. Cent. China.—*B. trifoliàta*, Hartw.=Mahonia trifoliolata.—*B. trifoliòlàta*, Moric.= Mahonia trifoliolata.—*B. trifùrca*, Forbes=Mahonia japonica var. trifurca.—*B. umbellàta*, Wall. Deciduous shrub: branches angular, gray: lvs. oblanceolate, usually entire, rarely sparsely serrulate: racemes long-peduncled, usually umbel-like, sometimes elongated. Himalayas. B.R. 30:44.—*B. Veitchii*, Schneid. Allied to B. levis. Evergreen shrub: lvs. narrow-lanceolate, acuminate, sinuately toothed with long and strong spines, 2–4 in. long: fls. 5–8, slender-stalked: fr. ovoid, bluish black. Cent. China.—*B. Verschaffèltii*, Schneid. (B. Jamesonii, Lem., not Lindl.). Evergreen shrub: lvs. oblong, 2–3 in. long, sparingly spiny-toothed: fls. orange in drooping panicles. Ecuador. I.H. 6:201.—*B. virescens*, Hook. Deciduous shrub, 2–5 ft.: branches yellowish red or red, lustrous, terete: lvs. obovate, ½–1¼ in. long, spiny-toothed or entire, light green, whitish beneath: fls. pale yellow, few, fascicled or in peduncled umbel-like racemes: fr. purple, bloomy. Himalayas. B.M. 7116.—Graceful shrub. Hardy at the Arnold Arboretum.—*B. Wallichiàna*, DC. Allied to B. Sargentiana. Evergreen shrub, to 10 ft.: branches grooved, spiny: lvs. elliptic to lanceolate, spiny-serrate with numerous small teeth, lustrous above, light green beneath, reticulate, 2–4 in. long: fls. 10–20; pedicels about ½in. long: fr. ovoid, black, with usually 1 long-stalked seed. Himalayas. P.F.G. 1, p. 79. Var. *latifòlia*, Hook. f. & Thoms. (B. Knightii, Hort., not. Koch. B. macrophylla, Hort.). Branchlets less grooved: lvs. broader, thinner.— *B. Wallichiàna*, Hook.=B. Hookeri.—*B. yunnanénsis*, Franch. Allied to B. diaphana. Branches grooved, gray: lvs. obovate-oblong, 1 in. long, entire, glaucous beneath: fls. 3–5, fascicled. S.W. China. —Has been confused with B. diaphana. See page 3566.

ALFRED REHDER.

BERCHÈMIA (derivation uncertain). *Rhamnàceæ*. Ornamental woody climbers, grown chiefly for their bright green graceful foliage.

Deciduous twining shrubs: lvs. alternate, entire or nearly so, petioled, with conspicuous numerous parallel veins: fls. perfect; sepals, petals and stamens 5; calyx-tube shallow; ovary free, 2-celled, with a 2-parted style: drupe oblong to cylindric with a 2-celled stone.—About 12 species in S. and Cent. Asia, N. Amer. and E. Afr.

These slender climbing shrubs have inconspicuous greenish white flowers in terminal panicles followed by berry-like, small, usually oblong, black or red fruits. The cultivated species are not quite hardy North and prefer sunny positions; they grow in almost any soil and are useful for trellis-work, when no dense shade is desired. Propagation is by seeds and by root-cuttings in spring under glass; also by layering the young shoots and by cuttings of mature wood in fall under glass.

scándens, Koch (*B. volùbilis*, DC.). SUPPLE-JACK. Ten to 15 ft.: lvs. ovate or oblong-ovate, acuminate, often undulate, 1–3 in. long, with 9–12 pairs of lateral veins: fls. greenish white in small terminal panicles: fr. bluish black, ¼–⅓in. long. June. Southern states. B.B. 2:404. S.O.B. 3:153.

racemòsa, Sieb. & Zucc. Closely allied to the former. Lvs. cordate, ovate, 1–2½ in. long, with 6–8 pairs of veins: fls. greenish in large terminal panicles: fr. first red, becoming black at length. July. Japan, China.—Hardier than the former, not high-climbing; attractive in late summer, with its red frs.

B. Giraldiàna, Schneid. Allied to B. racemosa. Lvs. ovate-oblong, 1–3 in. long, grayish white beneath, with 9–11 pairs of veins; petioles ¾in. long. W. China.—*B. lineàta*, DC. Allied to B. scandens. Lvs. smaller, oblong-ovate, obtuse, with about 9 pairs of veins, grayish white beneath. N. and W. China.

ALFRED REHDER.

BERGAMOT. Name applied to various aromatic plants, particularly to members of the *Labiatæ*, as menthas and monardas. The bergamot essence of commerce is made from a citrous fruit. See *Citrus*.

BERGEROCÁCTUS (named for Alwin Berger, Curator of the Hanbury Garden, at La Mortola, Italy). *Cactàceæ*. A low, much-branched, day-blooming cactus with cylindrical, low-ribbed sts.: areoles close together,

bearing many yellow spines: corolla short, funnel-shaped, greenish yellow: fr. globose, densely spiny.—A single species known.

Émoryi, Brit. & Rose (*Cèreus Émoryi,* Engelm.). Prostrate or ascending, 6–10 in. high, 1–2 in. diam., often forming thick masses 10–20 ft. in diam.: fls. 1–2 in. broad: fr. 1–1½ in. diam. On mainland and isls. of S. Calif., and N. Low. Calif.—This species, native of Calif., can easily be grown in the open in the southern part of that state. It forms large masses and care must be taken that it does not preëmpt more than its share of the garden. The species has long been in the trade, but it does not do well in the greenhouse, and it is hardly to be recommended for the small collection. Its slender sts., covered with striking yellow spines, are very unlike any of our other cereus-like plants.

J. N. Rose.

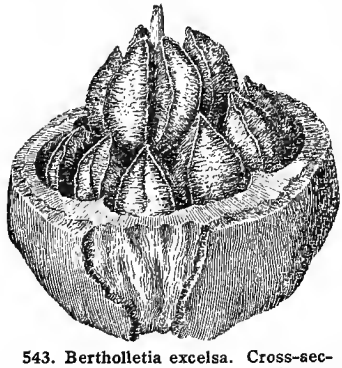
BERMUDA GRASS: *Cynodon dactylon.*

BÉRRIA (after Dr. Andrew Berry, a Madras botanist). Syn., *Berrya,* DC., not Klein. *Tiliàceæ.* A timber tree of India, which has been sparingly introduced into this country. One species.

Ammonílla, Roxbg. High tree: lvs. entire, heart-shaped, long-petioled, smooth, 5–7-nerved, alternate: fls. in. racemes, small, white, very numerous: fr. a 3-celled caps. with 6 wings, the 3–12 seeds with stiff hairs, which readily penetrate the skin and produce a painful itching.—Grows abundantly in British India, Ceylon, the Malay Archipelago, and the Philippines. The wood is smooth-grained, yellow, with dark red heart; used for house-building, agricultural implements, oil-casks, boats, and the like. Exported as "trincomalee wood." G. T. Hastings.

BERSÀMA (Abyssinian name). *Sapindàceæ.* Trop. and S. African trees and shrubs, of perhaps a half-dozen species, probably not cult. Lvs. alternate, odd-pinnate; lfts. entire or serrate: fls. silky, white, of 5 sepals and 5 unequal clawed petals. *B. usambarénsis,* Guerke, a recently described species from German E. Afr., has been discussed in horticultural journals: tree, 50 ft.: lvs. more than 2 ft. long, with winged rachis, the lfts. oblong-lanceolate and somewhat cut, prickly-margined.

BERTHOLLÈTIA (after Louis Claude Berthollet, French chemist). *Myrtàceæ.* Brazil-Nut. Butter-nut. Para-Nut. Cream-Nut. Nigger-Toe. Large trees: lvs. alternate, bright green, leathery, about 2 ft. long, 6 in. broad: fls. cream-colored; calyx parts united and tearing into 2 parts when the flower opens; petals 6; stamens many, united into a hood-shaped mass, the upper ones sterile: fr. round, about 6 in. diam., with a hard shell containing 18–24 3-sided nuts (Fig. 543).—Species several, all furnishing Brazil nuts and usually described as *B. excelsa.* The common trade name is Castanea, the name of the genus including the chestnuts.

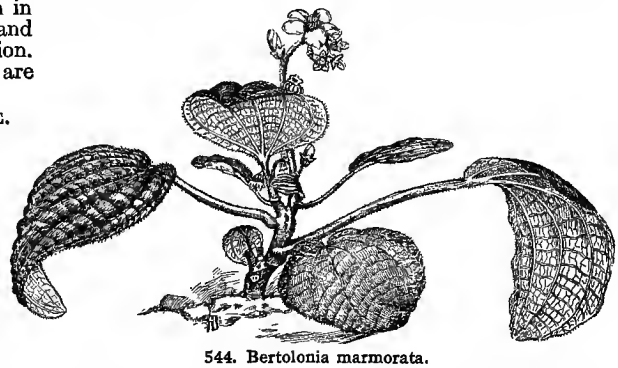


543. Bertholletia excelsa. Cross-section of husks, showing Brazil-nuts. (× ¼)

excélsa, Humb. & Bonpl. Fig. 543. A tree 100–150 ft. with a smooth trunk 3–4 ft. in diam.: branches near the top.—It forms large forests on the banks of the Amazon and Rio Negro. The natives gather the nuts in large quantities, chopping the fr. open. They are exported in large quantities, chiefly from Para. An oil is expressed from the kernels, and the bark is used at Para for caulking ships. The tree is of little value for decorative purposes, and, is too tender for growth anywhere in the U. S. G. T. Hastings.

BERTOLÒNIA (after A. Bertolini, Italian botanist). *Melastomàceæ.* Excellent warmhouse foliage plants from Brazil.

Always dwarf, and sometimes creeping; the garden forms with membranaceous, 5–11-nerved lvs. 5–8 in.



544. Bertolonia marmorata.

long, and purple beneath: fls. white, purple or rose-colored, 5-petaled, in scorpioid racemes or spikes. There are only 9 species, 5 of which were distinguished when the last edition was issued. (A. Coigneaux, in DC. Mon. Phan., Vol. VII.) Some earlier botanists do not separate certain allied genera which usually cannot be distinguished by habit alone. The surest character is the inflated and 3-angled or 3-winged calyx of Bertolonia. In Bertolonia, fl.-parts are in 5's, but the ovary is 3-celled. Gravesia has a 5-celled ovary, and Sonerila is trimerous. In Bertolonia, the connective of the anthers has no appendage; in Salpinga there is a spur below and behind the connective; in Monolena there is a spur in front, and the calyx is not hairy.

Bertolonias are essentially fanciers' plants. It is somewhat difficult to bring out their true characteristics under ordinary stove treatment, as they require a more humid atmosphere than can usually be maintained, even in a small house. The additional shelter of a small frame should be provided, where the atmospheric conditions will be much more easily regulated. A plentiful supply of water at the roots is necessary; syringing or sprinkling overhead is not advisable.—The most convenient method of propagation is by cuttings, which strike readily, in a moderately close propagating-case filled with sharp, clean sand. The pots should be thoroughly clean and drained, and the compost open and porous. They may also be grown from seed. They thrive in dense shade. Old plants are not so brilliant as young ones. (Wm. Scott.)

Bertolonias and their allies furnish an excellent example of Van Houtte's triumphs in hybridization. The two species described below have probably been important factors in the plant-breeding, and *Gravesia guttata* even more so. Gravesia is a Madagascar plant, and has, perhaps, been crossed with the Brazilian bertolonias. Unfortunately, the pictures in Flore des Serres show no flowers, and the pedigree is not given. The bertonerilas figured and described in I.H. 43, pp. 188 and 189, with colored plates 64 and 68, are presumably hybrids between Bertolonia and Sonerila. Excepting *B. maculata* and *B. marmorata,* the following are hybrids:

A. *Veins not lined on both sides with a colored band.*

marmoràta, Naudin. Fig. 544. St. less densely hairy than *B. maculata:* lvs. more narrowly ovate, ovate-

oblong, acute, sparsely hairy, streaked with white along the veins: calyx sparsely hairy, not glandular; petals somewhat blunter, dilute purple. R.H. 1848:381 (as *Eriocnema marmorata*, Naudin). F.S. 7:750 (as *B. maculata* var. *marmorata*, Planch.). Coigneaux recognizes 2 varieties, var. **genuìna,** with lvs. green above, and banded with white along the veins; var. **ænea,** (*E. ænea* and *B. ænea*, Naudin), with lvs. dark green with a coppery cast, but not spotted or only slightly so.

Mirándæi, Van Houtte. Spots red on the lower lvs. and white on the upper or younger ones: lvs. purple beneath. F.S. 21:2235 (1875).

AA. *Veins lined on both sides with a white or colored band.*

B. *Bands and spots magenta or purple.*

maculàta, DC. St. short, decumbent, rooting at the base, densely clothed with rusty hairs: lvs. long-petioled, cordate, broadly ovate, obtuse, hispid above and at margins, dark velvety green above, often spotted: calyx densely clothed with glandular hairs; petals obovate, somewhat acute, rose-colored. B.M. 4551.

Houtteàna, Van Houtte (*B. Van Houttei*, Hort.). Lvs. purple beneath. F.S. 20:2120.—This was a sensational plant of 1875, and Van Houtte refused $2,000 for his stock of it.

BB. *Bands and spots silvery white.*

C. *Spots very distinct.*

Hrubyàna, Van Houtte. This has bars of white connecting the veins. The under side of the lvs. seems to be green instead of purple, at least toward the tip. F.S. 23:2381.

Rodeckiàna, Van Houtte. Distinguished from the above and all others of this group by the abundance of dark red color on the upper surface of the lvs.: veins of the under side prominent and green. F.S. 23:2382.

CC. *Spots very faint.*

Legrelleàna, Van Houtte (*B. Legrélle*, Hort.). There are a few longitudinal bars, but they do not connect the veins. Referred to *Gravesia guttata* by Coigneaux. F.S 23:2407.

Other trade names are *B. guttàta*, Hook. f.=Gravesia guttata.—*B. margaritàcea*. Hort. Bull.=Salpinga margaritacea.—*B. primulæflòra*, Hort.=Monolena primulæflora.—*B. pubéscens*, Hort., with long white hairs, and a chocolate band down the center. Ecuador.—*B. punctatíssima*, Hort.—*B. superbíssima*, Hort. (B. superba?, Hort.), with rose-colored spots, which are larger and brighter near the margin. F.M. 151 (1875).—Probably a variety of Gravesia guttata.

WILHELM MILLER.
N. TAYLOR.†

BERTONERÌLA. A class of handsome foliage plants, presumably hybrids between Bertolonia and Sonerila. *Bertonerila* is a combination of the names *Bertolonia* and *Sonerila*. I.H. Vol. 43 (1896), pp. 188–190. For culture, see *Bertolonia*.—Rare in this country, perhaps not in cult. outside of a few botanic gardens. Some of the best-known forms are: Madame Cahuzae, Madame de Brezetz and Madame Treyeran.

BESCHORNÈRIA (after H. Beschorner, German botanist). *Amaryllidàceæ*. Succulent desert plants, allied to Bravoa, Fourcroya and Doryanthes, planted far south and in California, and sometimes seen in collections under glass in the North.

Leaves in a rosette, glaucous, roughish at the margins, not so thick, firm or fleshy as in Agave (which has a strong end-spine and horny marginal prickles): rootstock short, tuberous: fls. accompanied by showy colored bracts. In Beschorneria, the perianth is usually reddish green, funnelform but with a very short tube and with long, oblanceolate segms.; in Doryanthes the perianth is bright red, the segms. long, narrowly falcate; in Bravoa the perianth is red or white, the tube curved, sub-cylindrical, and the segms. short. From Fourcroya, to which the genus is closely related, Beschorneria is distinguished by its tubular-shaped perianth, long and narrow segms., thin and slender filaments, which are only slightly thickened below the middle. The perianth of Fourcroya is campanulate, with spreading, ovoid or elliptic segms., and short thickened filaments; the fourcroyas are larger plants, and without large showy bracts, and often produce bulbils, which Beschorneria never does.

The species are very closely allied, and difficult to distinguish. The following are the only kinds well known, and they are all from Mexico. If in good condition they bloom every year in warm countries from suckers of the previous year, but in the North they are likely to bloom only at long irregular intervals. The species succeed best when treated similarly to agaves, with the exception of the soil, which may be made richer by the addition of crushed bone and a little vegetable-mold. All of the species need greenhouse protection in the northern states. They are hardy in the warmest parts of the British Islands. Useful for bedding as striking foliage subjects.

tubiflòra, Kunth. No st. or trunk: lvs. 12 or more, 1½–2 ft. long, 1 in. broad, linear, long-acuminate, roughish on both surfaces, tufted, more or less recurved, thickened and triangular at base, minutely striated, glaucous-green: scape 4 ft., terminating in an erect raceme; fls. drooping, 2–4 together, the perianth divided to the top of the ovary, brownish green. B.M. 4642.—The oldest and best-known species.

Tonélii, Jacobi (*B. Toneliàna*, Jacobi). Allied to *B. tubiflora*, but with looser habit, much broader foliage, bright red-purple scape and a colored panicle with drooping branches, longer purple and red fls. with more acute segms.: st. or trunk very short: lvs. very glaucous, roughish beneath and on the margins, 15–20 in number, 1–1½ ft. long, 2–2½ in. broad, short-acuminate, and contracted below the middle into a flat thick petiole 1 in. broad. B.M. 6091.

Dekosteriàna, C. Koch (*B. Decosteriàna*, Baker). Lvs. 15–20 or more, 2–2½ ft. long, 2–2½ in. broad, oblanceolate, long-acuminate, very gradually tapering both ways from the middle, 1–1¼ in. broad above the base, which is very thick: fls. in a deltoid panicle, green, 1½ in. long, cut nearly to base, the ovary protruding. B.M. 6768.

bracteàta, Jacobi. Stemless: lvs. 20–30, 1½–2 ft. long, 2 in. broad, short-acuminate, texture thin but firm, contracted to less than 1 in. wide above the dilated base, glaucous green, scarious or dry on the margin: scape 4–5 ft., the panicle reddish brown; fls. 1½ in. long, segms. free but connivant, green, changing to yellowish red. B.M. 6641.

yuccoìdes, Hook. f. St. none, or apparently present by shedding of older lvs. in the rosette: lvs. about 20, 1–1½ ft. long, 2 in. broad, lanceolate, short-acuminate, narrowed to ½in. above the base, glaucous green: scape 3–4 ft., with fls. on drooping red branches in the panicle; fls. about 3 in. long, dark green, tinged yellow. B.M. 5203. G.C. III. 46:8, 309, 313.—The lvs. are broader than in *A. tubiflora*, shorter acuminate, and more boldly narrowed below the middle.

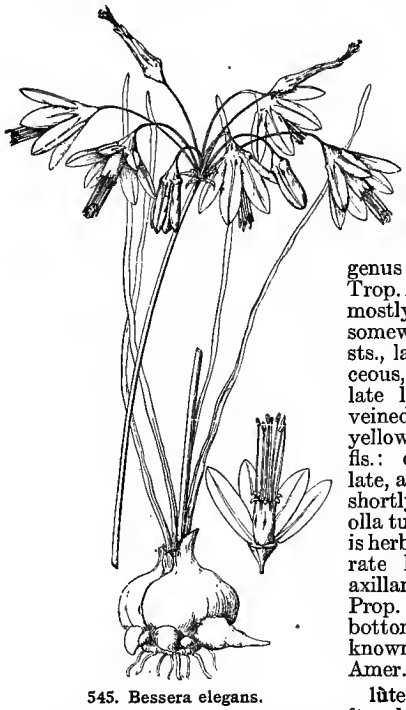
Wrìghtii, Hook. f. Allied to *B. Dekosteriana*, but fls. pubescent: st. or trunk 18 in.: lvs. about 50, densely crowded, spreading or recurved, ensiform, 4–5 ft. long by 2 in. at the middle, the tip narrowed to a long brown stiff point, the base dilated and very thick and bi-convex, the margins very narrowly scarious, denticulate: panicle pyramidal, 8 ft.; fls. fascicled, nodding, greenish, pubescent. B.M. 7779.

pubéscens, Berger. Smaller: lvs. 2 ft. long by 2 in. broad, glaucous, rather stiff and fleshy along the midrib, nearly smooth underneath, rough only near tip, margins finely and deeply denticulate: panicle 4–5 ft., rather slender, the scape bright red; fls. fascicled in axils of

ovate bracts, green, fading to yellow, pubescent. G.C. III. 40:350.

B. argyrophýlla, Hort.=B. Dekosteriana.—*B. califórnica* is a nomen nudum.—*B. supérba*, Hort. and *B. viridiflòra*, Hort.=B. yuccoides.

G. W. Oliver.
L. H. B.†



545. Bessera elegans.

BESLÈRIA (after Basil Besler, Nuremberg apothecary, and reputed author of the superb Hortus Eystettensis, 1613). *Gesneràceæ*. A genus of 50 species of Trop. American plants, mostly subshrubs, with somewhat 4-angled sts., large, membranaceous, opposite, petiolate lvs. prominently veined beneath, and yellow, white or purple fls.: calyx campanulate, at length globose, shortly 5-toothed; corolla tubular. *B. Imray* is herbaceous, with serrate lvs. and yellow axillary fls. B.M. 6341. Prop. by cuttings over bottom heat. None is known to be offered in Amer.

lùtea, Linn. St. 6–10 ft., glabrous or nearly so: lvs. elliptic or elliptic-oblong: calyx about half as long as the yellow slightly gibbous corolla. Trop. Amer.

N. Taylor.†

BÉSSERA (after Dr. Besser, professor of botany at Brody). *Liliàceæ*. Mexican Coral Drops. An exceedingly pretty summer-flowering bulbous squill-like plant.

Umbels pendulous; fls. vermilion outside, with a white corona or cup within, and long, purple stamens; perianth cup-shaped, the tube shorter than the oblong-lanceolate segms.; stamens 6.—A monotypic genus allied to Androstephium. Culture simple. Bulbs planted out, and lifted when ripe. May be prop. by offsets.

élegans, Schult. f. Fig. 545. Bulb globular, 1 in. thick, tunicated: lvs. 2–3, about 10–12 in., or even 2 ft., long: scape 1–2 ft. long, hollow, fragile; umbels 4–10-fld.; pedicels 1–1½ in. long; perianth 9–10 lines long, keeled on the back, variously marked with white within, but usually with vermilion margins and center-band; fls. borne through two months of late summer and early autumn. G.F. 4:125 (adapted in Fig. 545). Gn. 25:42. B.R. 1546 (as *Pharium fistulosum*); 25:34. F.S. 4:424 (as *B. miniatum*).—Strong bulbs sometimes throw up 6–10 scapes, with 12–20-fld. umbels.

Wilhelm Miller.

BÈTA (ancient name). *Chenopodiàceæ*. Beet-Root. Beet. Annuals in cultivation, or biennials by the wintering of the roots, grown for the thick edible roots, edible leaves, and ornamental foliage.

Glabrous, mostly thick-rooted herbs, with alternate, entire or sinuate lvs.: fls. perfect, bracted; perianth urn-shaped, 5-lobed, adhering at base to the ovary, becoming hardened in fr.; stamens 5 on a fleshy ring or disk; ovary partly inferior, in fr. covered by the withered and corky remains of the perianth; the fls. usually stand 2 or more together and cohere into a "seed" or "ball" that is more than 1-seeded.—The species of Beta are much confused, but probably all of them can be referred to a half-dozen species. Eu., N. Afr., Asia.

vulgàris, Linn. (*B. marítima*, Linn.). The supposed source of the cult. beets and foliage beets. Probably a development from the perennial beet of the coasts in parts of Eu., a much-branched decumbent plant (Fig. 546), with thick, long and hard (not really fleshy) perennial roots. In cult. forms, the plant is erect in fls. and fr., with greenish clustered fls., and ovate-oblong, smooth, more or less thick and wavy-margined lvs. There are 3 main races of the cult. beet-plant:

Var. **crássa**, Alef. Beet-Root. Beet of American gardens and fields, characterized by its thickened root of many forms, some of which are developed for their sugar-producing qualities. See *Beet*.

Var. **cruénta**, Alef. (*B. horténsis* and *B. rùbra*, Hort.). Red and Victoria foliage beets. Root not highly developed: lvs. large and showy, red or green, with yellow ribs. Var. *metállica* is a form of this. In many brilliant forms, often used in bedding and for strong color effects.

Var. **Cícla**, Moq. (*B. Cícla*, Linn. *B. brasiliénsis* and *B. chilénsis*, Hort.). Leaf-Beet. Sicilian Beet. Sea-Kale Beet. Spinach Beet. Chilian Beet. Roman Kale. Poirei. Root small and branched, not thick or fleshy: lvs. very large, thick-ribbed, green, yellow-green, reddish green or even red, often with very wide and thick petioles.—Used as a pot-herb. Differs widely in the coloration of the lf.-ribs, and shape and development of lf.-blade. One form of it is *Chard* (which see).

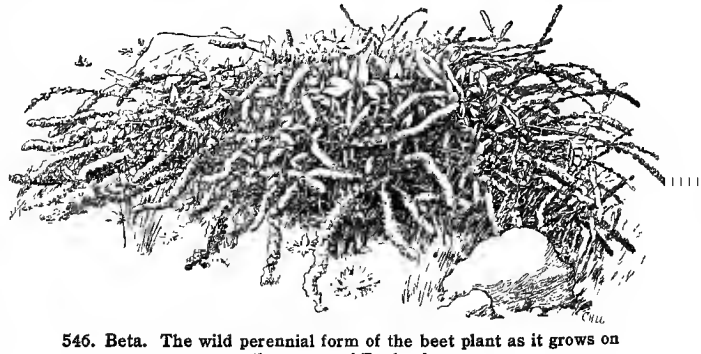
L. H. B.

BETEL, or BETLE. The leaf of *Piper Betle*, a kind of pepper used in wrapping the pellets of betel-nut and lime which are commonly chewed in the Orient. The pellets are hot, acrid, aromatic, astringent. They redden the saliva and blacken the teeth, and eventually corrode them. The betel-nut is the fruit of *Areca Catechu*, a palm. See pp. 16 and 24.

BETÓNICA and BETONY: *Stachys*.

BÉTULA (ancient Latin name). *Betulàceæ*. Birch. Ornamental deciduous woody plants grown chiefly for their bright green handsome foliage. Page 3566.

Trees or shrubs: winter-buds usually conspicuous, sessile, with several imbricate scales: lvs. alternate, petioled, serrate or crenate: fls. monœcious, apetalous, in catkins, staminate formed in autumn and remaining naked during the winter, every scale bearing 3 fls., each with a minute 4-toothed calyx and with 2 stamens divided at the apex; pistillate catkins oblong or cylindrical, bearing 3 naked ovaries in the axil of every scale



546. Beta. The wild perennial form of the beet plant as it grows on the coasts of England.

consisting of 3 connate bracts: fr. a minute nut, often erroneously called seed, with membranous wings, dropping at maturity with the 3-pointed scales from the slender rachis of the strobile.—About 35 species in N. Amer., Eu., N. and Cent. Asia, especially in the northern regions. No tree goes farther north than the birch, in N. Amer. *B. papyrifera* reaches 66° north latitude, and in Eu. *B. pubescens* goes to the N. Cape, and is still a forest tree at 70°. Monogr. by Regel: Monographische Bearbeitung der Betulaceæ (1861); and in De Candolle, Prodromus, 16, 2, p. 162 (1869); and by Winkler in Engler's Pflanzenreich: Betulaceæ, p. 56, quoted below as W. B.

The birches are often conspicuous on account of their colored bark, and slender usually pendulous staminate catkins before the leaves and much smaller pistillate catkins, followed by subglobose to cylindric strobiles. The hard and tough wood is often used in the manufacture of furniture and of many small articles, in making charcoal, and for fuel; from the bark, boxes, baskets, and many small articles are made; also canoes from that of the *B. papyrifera;* in Russia and Siberia it is used in tanning leather. The sap of some species is used as a beverage. The birches are very ornamental park trees, hardy, except two or three Himalayan species, and especially valuable for colder climates. They are essentially northern trees and are short-lived in warmer regions, particularly mountain species like *B. lutea*, while *B. nigra* and *B. lenta* are better suited for a warmer climate than most other species. Their foliage is rarely attacked by insects, and turns to a bright or orange-yellow in fall. Their graceful habit, the slender, often pendulous branches, and the picturesque trunks make them conspicuous features of the landscape. Especially remarkable are those with white bark, as *B. papyrifera*, *B. populifolia*, *B. pendula*, *B. Ermanii*, and also *B. Maximowiczii* with yellow bark.

Most birches prefer moist, sandy and loamy soil; but some, as *B. pendula* and *B. populifolia*, grow as satisfactorily in dry localities and poor soil as in swamps and bogs, and they are especially valuable in replanting deserted grounds as nurses for other trees; both are comparatively short-lived trees.

Propagation is readily accomplished by seeds, gathered at maturity and sown in fall, or usually kept dry during the winter, or stratified; but *B. nigra*, which ripens its fruits in June, must be sown at once, and by fall the seedlings will be several inches high. The seeds should be sown in sandy soil, rather thick, as the percentage of perfect seeds is not very large, slightly or not at all covered, but pressed firmly into the ground and kept moist and shady. The seedlings must be transplanted when one year old. Rarer species and varieties are grafted, usually on *B. lenta*, *B. papyrifera*, *B. nigra* or *B. pendula*. Cleft or tongue-grafting in early spring, on potted stock in the greenhouse, is the best method. Budding in summer is also sometimes practised. Shrubby forms may also be increased by layers, and *B. nana* by greenwood cuttings under glass.

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A. *Veins of lvs. 7 pairs or more, usually impressed above. Trees.*

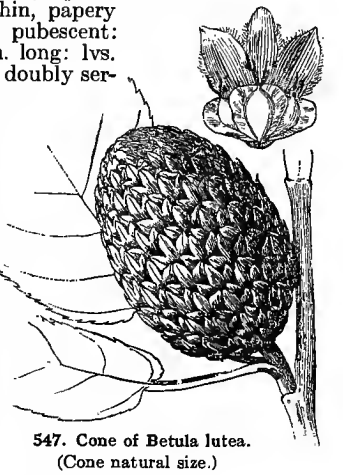
B. *Lvs. large, 4–6 in. long, deeply cordate: cones cylindrical, racemose, 2–4.*

1. **Maximòwiczii,** Regel. Tree, 80–90 ft., with smooth, orange-colored trunk and dark reddish brown branchlets: lvs. long-petioled, broadly ovate, coarsely and doubly serrate, membranous, pubescent on younger trees, nearly glabrous on older ones: cones ½–3 in. long, slender, nodding; fr. with very broad wings. Japan. B.M. 8337. S.I.F. 1:23. W.B. 90.—This is probably the most beautiful of all birches, perfectly hardy N. and of rapid growth; its large foliage and the yellow color of the trunk render it a highly ornamental and conspicuous park tree.

BB. *Lvs. 2–5 in. long: cones solitary: wings narrower than the fr.*

C. *Under side of lvs. glaucescent: lvs. rhombic-ovate, cuneate at base with 7–9 slightly impressed pairs of veins.*

2. **nìgra,** Linn. (*B. rùbra*, Michx.). Red or River Birch. Tree 50–90 ft.: bark reddish brown, or silvery gray on younger branches, separating into numerous thin, papery flakes: branchlets pubescent: petioles scarcely ½in. long: lvs. rhombic-ovate, acute, doubly serrate, pubescent when young, at length only on the veins beneath, pale or glaucescent beneath, 2–3½ in. long: cones 1–1⅔ in. long, cylindrical, ripening in May or June; scales pubescent, with erect, linear-oblong, nearly equal lobes. From Mass. south to Fla. and west to Kan. and Minn. S.S. 9:452. L.B.C. 13:1248. G. F. 2:591. Gn. 55, p. 161 (habit). W. B. 63. H.T. 122, 123.—A moisture-loving, graceful tree, with slender, very numerous branches, and remarkable for its torn and ragged bark.



547. Cone of Betula lutea. (Cone natural size.)

CC. *Under side of lvs. light green: lvs. rounded or truncate at the base, with 8–14 pairs of impressed veins.*

D. *Shape of lvs. ovate or oblong-ovate, rounded and often cordate at the base, broadest about the middle; veins distinctly impressed above: petioles less than ¾in. long.* See page 3566.

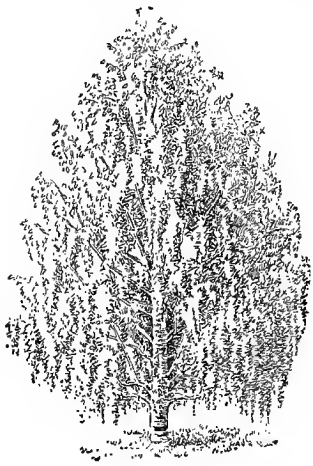
E. *Cones peduncled, cylindric.*

3. **ùtilis,** Don (*B. Bhojpáttra*, Wall.) Tree, 40–60 ft.: trunk with reddish brown bark: branchlets pubescent while young, not glandular: lvs. ovate, rounded at the base, acuminate, densely irregularly serrate, pubescent on the veins beneath, 2–3 in. long, with 8–12 pairs of veins: cones peduncled, cylindrical, 1–2 in. long, with erect oblong lobes, the middle one much longer. Himalaya. Japan. S.I.F. 1:23.—Not quite hardy N.

EE. *Cones sessile or nearly sessile, ovoid or ovoid-oblong.*

4. **lènta,** Linn. (*B. carpinifòlia*, Ehrh.). Cherry, Sweet, or Black Birch. Tree, 60–70 ft.: trunk dark reddish brown, young bark aromatic, of agreeable flavor: lvs. oblong-ovate, usually cordate at the base, sharply and doubly serrate, hairy beneath when young, nearly glabrous at length, 2–5 in. long: cones ovoid-oblong, 1–1½ in. long; scales about ⅛in. long, lobed

only at the apex, the middle lobe slightly longer. From Maine to Ala., west to eastern Ohio. S.S. 9:448. H.T. 124, 125. Em. 232.—Very handsome tree, round-headed, and with pendulous branches when older; attractive in spring, with its long staminate catkins. Bark and lvs. largely used in domestic practice; branches and foliage yield an oil very similar to oil of wintergreen, and employed for all conditions in which the latter proves useful; bark as well as the oil much used for flavoring.



548. Betula pendula.

5. **lùtea,** Michx. (*B. excélsa,* Pursh, not Ait.). YELLOW BIRCH. Fig. 547. Tree, sometimes 100 ft.: bark silvery gray or light orange, on old trunks reddish brown; young bark aromatic, but somewhat bitter: branchlets usually pilose: lvs. ovate or oblong-ovate, usually rounded at the base, acuminate, sharply and doubly serrate, usually hairy along the veins beneath: cones like the last, but thicker; scales nearly ⅓in. long, lobed to the middle, pubescent outside. From Newfoundland west to Minn., south along the Alleghanies to the high peaks of N. C. and Tenn. S.S. 9:449. Em. 235. H.T. 126, 127.—One of the most valuable forest trees in the northern states, much resembling the former in habit. Var. **persicifòlia,** Dipp., has larger and longer lvs., often ovate-lanceolate.

DD. *Shape of lvs. ovate, broadest near the base and usually truncate or sometimes cordate: veins not impressed above: petioles to 1 in. long.*

6. **ulmifòlia,** Sieb. & Zucc. (*B. costàta,* Trautv.). Tree, 50 ft.: bark yellowish brown: branches not, or slightly glandular: lvs. ovate, rarely oblong-ovate, irregularly doubly serrate, with 9–14 pairs of veins, long-acuminate, 2–3½ in. long, hairy when unfolding, glabrous at maturity: cones elliptic; scales glabrous, with short, rhombic or obovate lateral lobes; wings about half as broad as nutlet. Japan. Manchuria. S.I.F. 1:22. W.B. 63.

7. **Ermánii,** Cham. Tree, 60 ft.: trunk white: branches yellowish white or orange-colored; branchlets usually glandular and pubescent when young: lvs. broadly triangular-ovate, acuminate, irregularly coarsely serrate, 2–4 in. long, hairy when unfolding, with 7–10 pairs of veins: cones oblong; scales pubescent, with linear-oblong lobes, middle one somewhat longer; wings about one-third as broad as nutlet. N. E. Asia, Japan. S.I.F. 1:22. W.B. 63.—Handsome round-headed tree, with slender branches. See page 3566.

AA. *Veins of lvs. 7 or less pairs, not impressed.*

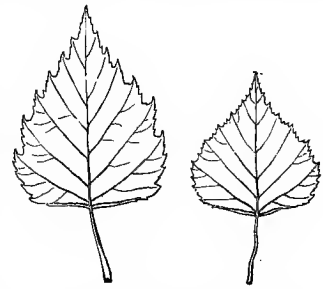
B. *Wings usually broader than the nut.*

C. *Bark white.*

D. *Branchlets glabrous and glandular: lvs. usually rhombic-ovate: scales of strobiles with divergent broad lobes larger than the middle lobe.*

8. **populifòlia,** Ait. (*B. álba* var. *populifòlia,* Spach). WHITE BIRCH. Small tree, exceptionally 40 ft., with smooth white bark: branchlets with numerous resinous glands: lvs. slender, petioled, triangular or deltoid, long-acuminate, coarsely doubly serrate, glutinous when young, glabrous at length and shining: cones slender, stalked, cylindric, about 1 in. long; bracts pubescent, the lateral lobes divergent, about as long as the middle one. From New Brunswick to Del., west to Ont. S.S. 9:450. H.T. 118, 119. Em. 1:242.—A small, graceful, but short-lived tree, yet thriving in dry and poor soil. Var. **laciniàta,** Loud. Lvs. incised-laciniate. Var. **péndula,** Loud. Branches distinctly pendulous. Var. **purpùrea,** Ellwanger & Barry. Lvs. purple when young, green at length. *B. populifolia* × *B. papyrifera* is shown in G.F. 8:356. It has been found wild in several localities, but is apparently not in cult.

9. **péndula,** Roth (*B. verrucòsa,* Ehrh. *B. álba,* Linn., in part). Figs. 548, 549. Tree, to 60 ft., with slender, in older trees usually pendulous, branches: young branchlets usually glandular: lvs. rhombic-ovate, ¾–2½ in. long, glutinous when young, glabrous, usually cuneate, sometimes truncate at the base, acuminate, doubly serrate; petioles slender, about 1 in. long: strobiles cylindric, about 1 in. long, slender-peduncled, usually pendulous: wings of nutlet about one and a half to two and a half times as broad as its body. Eu. to Japan. H.W. 2:15, p. 20. W.B. 76. Var. **Taûschii,** Rehd. (*B. japónica,* Sieb. *B. álba* var. *Taùschii,* Shirai. *B. péndula* var. *japònica,* Rehd.). Lvs. broadly ovate, truncate or sometimes subcordate at the base, sometimes puberulous beneath and often with tufts of hairs in the axils. S.I.F. 1:21. Var. **dalecárlica,** Schneid. (*B. laciniàta,* Wahl. *B. hýbrida,* Blom). Lvs. more or less deeply lobed with irregularly serrate-acuminate lobes: branches on older trees pendulous.—A very graceful tree. Var. **fastigiàta,** Koch (*B. álba fastigiàta,* Carr. *B. péndula pyramidàlis,* Dipp.). With straight upright branches, forming a narrow columnar pyramid. G.C. III. 41:151. M.D.G. 16:164. Var. **trístis,** Schneid. With very slender, strongly pendulous branches, forming a round regular head. Var. **Youngii,** Schneid. (*B. álba péndula Youngii,* Moore. *B. péndula élegans,* Dipp. *B. álba elegantíssima péndula,* Hort.). Branches very slender, strongly pendulous; primary branches spreading or recurved, forming an irregular picturesque head; similar in habit to the weeping beech. F. 1873, p. 60. R.H. 1869, p. 136. Gn. 6, p. 528. Var. **grâcilis,** Rehd. (*B. álba laciniàta grácilis péndula,* Hort. *B. élegans laciniàta,* Hort.). Habit like the preceding, with laciniate lvs. Much slenderer and smaller and of slower growth than var. *dalecarlica.* Var. **purpùrea,** Schneid. (*B. vulgàris purpùrea,* André. *B. álba atropurpùrea,* Lauche. *B. pubéscens atropurpùrea,* Zabel). Lvs. dark purple. R.B. 4:185.



549. Leaves of Betula pendula. (×½)

DD. *Branchlets pubescent and slightly glandular or glandless: lvs. generally ovate, rounded at the base: bracts with the lateral lobes upright or spreading, shorter than the middle lobe.*

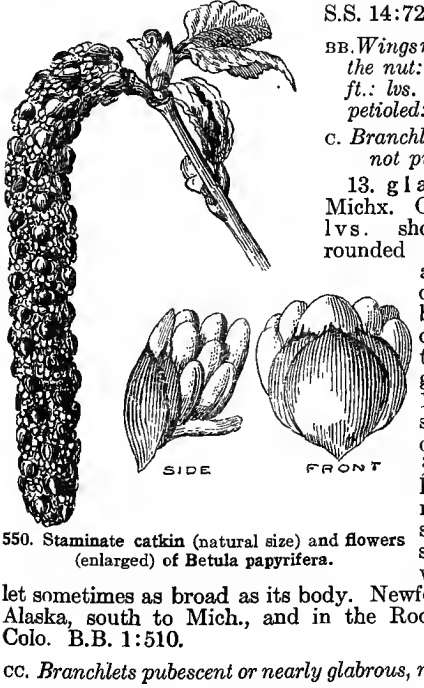
10. **pubéscens,** Ehrh. (*B. odoràta,* Bechst. *B. álba,* Linn., in part). Tree, to 60 ft.: branches upright or spreading, rarely pendulous in old trees; branchlets pubescent and glandless: lvs. ovate or rhombic-ovate, 1–2 in. long, rounded, truncate or cuneate at the base, acute, usually unequally and doubly serrate, pubescent beneath, at least while young: strobiles cylindric, about 1 in. long, upright or nodding; scales puberulous, lateral lobes upright or spreading, rarely recurved. N. and Cent. Eu. to E. Siberia. H.W. 2, pp. 24, 25. Var.

urticifòlia, Spach (*B. urticifòlia,* Regel. *B. álba asplenii-fòlia,* Hort.). Lvs. small, deep green, irregularly incised. Var. **variegàta,** Zabel (*B. álba fòliis variegàtis,* Hort.). An inconstant form with variegated lvs. There are also a number of geographical varieties as var. **carpàtica,** Koch; var. **songàrica,** Regel; var. **tortuòsa,** Koehne; var. **Muríthii,** Gremi, which are rarely met with in cult. and horticulturally are of no importance. —In the wild state this species is generally found in moist places, often in swamps, while the preceding species prefers drier situations.

11. **papyrífera,** Marsh. (*B. papyràcea,* Ait. *B. grándis,* Schrad.). PAPER or CANOE BIRCH. Figs. 550, 551. Tree, 60–80, exceptionally 120, ft.: branchlets slightly glandular, hairy when young: lvs. ovate, narrowed to cordate at the base, acuminate, coarsely and usually doubly serrate, pubescent on the veins beneath or nearly glabrous, 1½–4½ in. long: strobiles peduncled, 1–2 in. long; scales with short and broad divergent lateral lobes. Northern states from the Atlantic to Pacific coast. S.S. 9:451. Em. 238. G.F. 8:223. H.T. 120, 121. I.T. 4:125.—Ornamental tree, with very white trunk and a loose, graceful head when older. Bark known for its use in making Indian canoes. Var. **cordifòlia,** Regel (*B. pyrifòlia* and *B. platyphýlla,* Hort.). Lvs. broadly ovate, usually cordate. S.S. 14:724. Var. **mìnor,** Tuckm. Low, bushy tree with smaller lvs. and frs. Mts. of New England and N. Y.

CC. *Bark orange-brown: branchlets glandular and hairy when young: lateral lobes of scales upright, shorter than the middle lobe.*

12. **occidentàlis,** Hook. (*B. Lyalliàna,* Koehne. *B. papyràcea* var. *occidentàlis,* Dipp.). Tree, to 100 ft.: branches in older trees often pendulous: lvs. ovate, 3–4 in. long, usually rounded at the base, acute, coarsely and mostly doubly serrate, resinous while young and villous on the veins, glabrous at maturity except on the puberulous veins: strobiles cylindric, 1¼–1½ in. long; scales ciliate, with rhombic-ovate upright lateral lobes, about half as long as the oblong middle lobe. B. C. to Wash. S.S. 14:725.



550. Staminate catkin (natural size) and flowers (enlarged) of Betula papyrifera.

BB. *Wings narrower than the nut: shrubs, 1–15 ft.: lvs. small, short-petioled: cones erect.*

C. *Branchlets glandular, not pubescent.*

13. **glandulòsa,** Michx. Only 1–4 ft.: lvs. short-petioled, rounded or cuneate at the base, orbicular or broadly obovate, obtuse, dentate, glabrous, ¼–1½ in. long: strobiles peduncled, ½–¾in. long; lobes of scales nearly equal, slightly spreading; wings of nutlet sometimes as broad as its body. Newfoundland to Alaska, south to Mich., and in the Rocky Mts. to Colo. B.B. 1:510.

CC. *Branchlets pubescent or nearly glabrous, not glandular.*

14. **pùmila,** Linn. Usually 2–8, rarely 15, ft.: branchlets tomentose or pubescent, at least when young: lvs. orbicular or oval, acute or obtuse, coarsely dentate, pale and glabrous or pubescent beneath, ½–2 in. long: strobiles peduncled, ½–1 in. long; lateral lobes of the pubescent scales spreading, shorter than the middle one; wings of nutlet half as broad as its body or narrower. Newfoundland to Minn., south to Ohio. B.B. 1:511. W.B. 71. Var. **fastigiàta,** Rehd. (*B. hùmilis fastigiàta,* Hort.). Shrub, with upright branches, forming a narrow pyramid: branchlets soft pubescent: lvs. broadly rhombic to suborbicular, 1–1½ in. long, broadly cuneate at base, pubescent beneath only on the veins, resin-dotted on both sides.

551. Catkin of Betula papyrifera. (×½)

15. **nàna,** Linn. Low, spreading, rarely 4 ft.: lvs. orbicular or cuneate-obovate, crenate, rounded at apex, glabrous, ¼–¾in. long: strobiles nearly sessile, ¼–½in. long; the upper scales usually entire, the lower ones 3-lobed; wings of nutlets very narrow. Arctic N. E. Amer., N. Eu., Siberia. B.B. 1:511. W.B. 71.—A low, graceful shrub for rockeries and rocky slopes.

B. acuminàta, Wall.=B. alnoides.—*B. alaskàna,* Sarg. Allied to B. occidentalis. Tree, to 40, rarely 80, ft.: bark grayish white: branchlets densely glandular: lvs. rhombic-ovate, 1½–3 in. long, truncate to broadly cuneate, pubescent on the veins beneath or finally glabrous; petiole about 1 in. long: scales of strobiles ciliate. Alaska. S.S. 14:726.—*B. alleghaniénsis,* Brit. Intermediate between B. lenta and B. lutea. Bark either close and furrowed or peeling off in thin flakes: young branchlets pubescent: lvs. usually cordate at base and pubescent beneath: strobiles ovoid-oblong, about 1 in. long; scales ¼in. long, 3-lobed about to the middle. Que. and Mich. to Ga.—*B. alnoides,* Hamil. (B. acuminata, Wall. B. cylindrostachya, Wall.). Allied to B. Maximowiczii. Tree, to 60 ft.: young branchlets pubescent; bark brown: lvs. ovate-oblong to ovate-lanceolate, 2½–6 in. long, rounded at the base, doubly cuspidate-serrate, with 10–13 pairs of veins: strobiles in racemes. Himalayas, S.W. China. W.B. 90.—*B. alpéstris,* Fries=B. intermedia.—*B. Borggrèvei,* Zabel (B. papyrifera × B. pumila). Shrubby. Intermediate between the parents, but more similar to B. pumila. Raised at Hann., Muenden, Germany, from American seed.—*B. cærùlea,* Blanch. Allied to B. pendula. Tree, to 60 ft.: young branchlets hairy: lvs. ovate, 2–3½ in. long, rounded or cuneate at base, acuminate, sharply serrate, dull bluish green above, slightly hairy along the veins beneath: scales of strobiles similar to those of B. populifolia. Vt., Me. S.M. 201.—*B. carpinifòlia,* Sieb. & Zucc.= B. grossa.—*B. carpinifòlia,* Ehrh.=B. lenta.—*B. corylifòlia,* Regel. Allied to B. nigra. Lvs. broadly elliptic or obovate, 1¾–2½ in. long, coarsely dentate, silky on the veins beneath, with 10–14 impressed pairs of veins: strobiles cylindric. Japan. S.I.F. 2:14. W.B. 60.—The plant cult. under this name is usually B. Ermanii.—*B. cylindrostàchya,* Wall.=B. alnoides.—*B. dahùrica,* Pall. Allied to B. pubescens. Tree, to 60 ft.: bark brown: branchlets glandular, hairy when young: lvs. ovate, 1–2 in. long, pubescent on the veins beneath: strobiles oblong; wings of nutlet half as broad as body or less. Dahuria, Manchuria. Pallas, Fl. Ross. 39.—*B. excélsa,* Ait. (B. alba var. excelsa, Regel). Allied to B. pubescens. Large tree: bark yellowish brown: young branchlets densely pubescent: lvs. broadly ovate to obovate, 1–2½ in. long, rounded or subcordate at the base, acute, pubescent beneath: strobiles cylindric-oblong, upright or nodding; lateral lobes of scales slightly shorter than the middle one. Of unknown origin. W.D.B. 2:95. N.D. 3:52.—*B. fontinàlis,* Sarg. (B. occidentalis, Nutt., not Hook. B. rhombifolia, Nutt., not Tausch). Allied to B. occidentalis. Small tree, to 40 ft. or shrubby: bark dark bronze color, lustrous: branchlets glandular: lvs. broadly ovate, 1–2 in. long, truncate to broadly cuneate, sharply, often doubly serrate: strobiles cylindric-oblong, 1–1¼ in. long; scales glabrous or puberulous. B. C. to Calif., east to Dak. and Colo. S.S. 9:453 (as B. occidentalis).—*B. fruticòsa,* Pall. (B. Gmelinii, Bunge). Allied to B. glandulosa. Shrub, to 15 ft.: branchlets glandular and pubescent: lvs. ovate-elliptic, ½–1½ in. long, glabrous at length and usually glandular beneath: strobiles oblong-cylindric, ¾–1 in. long, wings about as broad as nutlet. Siberia, Manchuria. Pallas, Fl. Ross. 40.—*B. globispìca,* Shirai. Allied to B. ulmifolia. Tree, to 60 ft.: bark grayish brown: lvs. broadly rhombic-ovate, 1½–2½ in. long, short-acuminate, unequally serrate, with about 10 pairs of veins, pubescent on the veins beneath: strobiles subglobose or ovoid, about 1½ in. long; scales deeply 3-lobed with spatulate lobes. Japan. S.I.F. 1:21. W.B. 68.—*B. Gmélinii,* Bunge=B. fruticosa. —*B. grössa,* Sieb. & Zucc. (B. carpinifolia, Sieb. & Zucc.). Tree: branchlets glabrous: lvs. ovate, 2–4 in. long, unequally serrate, with 10–15 pairs of veins, pubescent on the veins beneath and glandular-punctate: strobiles nearly sessile, elliptic-ovoid; middle lobe of the scale slightly longer than the lateral ones. Japan. S.I.F. 1:22.—*B. hùmilis,* Schrank. Allied to B. glandulosa. Shrub, 2–6 ft.: branchlets glandular and slightly pubescent at first: lvs. ovate or suborbicular, ½–1¼ in. long, crenately serrate, glabrous: strobiles ovoid, about ½in. long. N. and W. Eu., N. Asia. G.W.H. 2:149. H.W. 2:

p. 26. R.F.G. 12:1279.—*B. intermèdia,* Thomas (B. alpestris, Fries. B. pubescens×B. nana). Shrub: lvs. orbicular or ovate, ½–1 in. long, crenate-serrate, usually pubescent while young, and often glutinous, finely glabrous: strobiles oblong; lateral lobes of scale upright and usually shorter than the middle one. N. Eu.—Natural hybrid; very variable.—*B. Jáckii,* Schneid. (B. lenta×pumila). Shrub: bark of the odor of B. lenta: lvs. usually obovate, 1–2 in. long, usually with about 7 pairs of veins: strobiles oblong, ½–¾ in. long; lateral lobes of scales spreading, somewhat shorter than the middle one. Originated at the Arnold Arboretum. G.F. 8:245.—*B. kenàica,* Evans. Allied to B. occidentalis. Tree, to 40 ft.: bark grayish white or light reddish brown: branchlets glabrous, not or slightly glandular: lvs. ovate, 1½–2 in. long, cuneate or rounded at the base, irregularly, often doubly serrate, glabrous: strobiles cylindric-oblong, about 1 in. long, glabrous. Alaska. S.S. 14:723.—*B. Kèhnei,* Schneid. (B. papyrifera×pendula). Intermediate between the parents. Tree: branchlets sparingly pubescent: lvs. ovate, 2–3½ in. long, usually truncate at base, acuminate; rather finely and doubly serrate: scales of strobiles similar to those of B. papyrifera. Origin unknown.—*B. luminifera,* Winkl. Allied to B. alnoides. Lvs. ovate, subcordate at the base, serrate with acuminate teeth, 3–5 in. long: strobiles solitary, 2-3 in. long. Cent. China. W. 92.—*B. Medwedjewii,* Regel. Allied to B. utilis. Tree: young branchlets hairy: lvs. broadly ovate to obovate, 2–3 in. long, rounded or sometimes subcordate at the base, short-acuminate, glabrous or pubescent on the veins beneath: strobiles cylindric-oblong, 1–1¾ in. long; wings of nutlet often 4 times narrower than its body. Caucasus. Gt. 36, p. 384.—*B. occidentàlis,* Nutt., not Hook.=B. fontinalis.—*B. Purpùsii,* Schneid. (B. lutea×pumila). Shrubby or small tree: lvs. oblong-ovate, 1–2 in. long, with 7–9 pairs of veins, soft-pubescent beneath. Intro. to Eu. from Mich.—*B. Raddeàna,* Trautv. Tree: lvs. ovate-pubescent on the veins beneath, with 6–7 pairs of veins, 1–2 in. long: strobiles oblong, upright, ¾in. long; wings as broad as nutlet. Caucasus. Gt. 36, p. 384.—*B. rhombifòlia,* Nutt.=B. fontinalis.

ALFRED REHDER.

BIÀRUM (old and obscure name). Incl. *Ischarum. Aràceæ.* Dwarf, tuberous perennials of the same tribe with our native jack-in-the-pulpit. They are hardy in England, but probably are suitable only for pot-culture in the Northern United States.

Biarums have a spathe which is tubular at the base, mostly with a long limb, and usually a long tail-like spadix; otherwise much as in Arum. They grow a few inches high. Odd. Little known in Amer. A few species in Eu. and Asia Minor.

tenuifòlium, Schott (*Árum tenuifòlium,* Linn.). Lvs. linear-lanceolate or spatulate, appearing after the fls. decay: spathe long-acuminate, at length recurved and twisted spirally, about 10 in. long, outside green, streaked purple; inside dull purple, spotted; margins wavy; spadix 15 in. long. Spain. B.M. 2282.

Pyrâmii, Engler (*Ischárum Pyrámii,* Schott). Lvs. oblong above the middle, narrowing abruptly to a very long petiole, resembling *Calla palustris:* spathe green outside, shining, velvety purple within, shorter and broader than in *B. tubiflorum,* at length revolute; tube swelling, connate only at the very base; spadix thicker and shorter. Syria. B.M. 5324.

Bòvei, Blume. Lvs. similar to *B. Pyramii;* spathe-tube connate a fourth of its length; blade of spathe longer and more narrowly lanceolate, green outside, dark purple within. Syria, Asia Minor. L. H. B.

BÌDENS (Latin, *two-teeth,* in reference to the awns). *Compósitæ.* BUR-MARIGOLD. STICK-TIGHTS. TICK-SEED. Annual, or rarely perennial, herbs, mostly American, related to Coreopsis, Dahlia, and Cosmos.

Leaves opposite, serrate or incised, often pinnately or ternately divided: heads radiate or discoid; rays yellow or white; disk yellow; involucre double, the outer set of bracts green and more or less foliaceous, the inner of quite different texture and shape, more appressed, thinner, more scarious and striate: achenes flat or angled; pappus of 2–4 stiff bristles or awns, usually retrosely barbed.—Plants grown as garden annuals. *B. frondosa,* a common weed, is the well-known bootjack bur, or stick-tight.

A. *Achenes obovate or cuneate-oblong, more or less flattened or triangular, the faces uni-costate: texture of lf. medium.*

B. *Size of achenes small (1–2 lines long) with firm glabrous margins: inner involucre dark dotted.*

coronàta, Fisch. (*Coreópsis aùrea,* Ait.). St. 1–4 ft. high, branched above, glabrous or nearly so: lvs. ternately or pinnately divided: outer involucre about equaling the dark-dotted inner: achenes dark, very small, 1–2 lines long, narrowly cuneate, 3-angled, margin firm and glabrous; pappus of 2–4 minute awns and some chaff. S. E. U. S.—Very variable.

BB. *Size of achenes larger (2–4 lines long) with hispid margins: involucre not dotted.*

trichospérma, Brit. (*Coreópsis trichospérma,* Michx.). St. tall, 2–5 ft. high, glabrous, branched above: lvs. pinnatifid: outer involucre about equaling the undotted inner: achenes dark, larger, 2½–4 lines long, cuneate, moderately flat, margin firm, usually pubescent; pappus of 2 upwardly hispid broad-based awns about ½ line long. E. U. S. Var. **tenuifòlia,** Brit. Lf.-segms. narrowly linear: achenes 2–3 lines long.

aristòsa, Brit. (*Coreópsis aristòsa,* Michx.). St. 1–4 ft. high, branched above, nearly or quite glabrous: lvs. pinnatifid, often pubescent beneath: outer involucre about equaling the undotted inner: achenes olive or brownish, large, 2–4 lines long, broad and very flat 1–2½ lines broad, abruptly contracted at summit, margin thin and hispid, often crenulate; pappus awns 2, each 1–2 lines long, divergent, stramineous, upwardly or downwardly barbed, or sometimes entirely wanting. Cent. U. S. B.M. 6462. R.H. 1869:72.

AA. *Achenes linear-spindle-shaped, tapering gradually above, angled or costate: texture of lf. usually firmer.*

B. *Lvs., in part, finely dissected: rays large, golden yellow.*

grandiflòra, Balb. St. 1–4 ft. high, branched, glabrous and somewhat glaucous: lvs. pinnatifid, the divisions either lanceolate and serrate or dissected into narrowly linear divisions: outer involucre about equaling the more or less hirsute inner; rays large, golden yellow: achenes 3–6 lines long; awns 2, downwardly barbed, about 1 line long. Mex.—A showy plant sometimes cult. in Amer.

BB. *Lvs. or their divisions lanceolate to ovate: rays pale yellow or whitish.*

Warszewicziàna, Regel. Erect, glabrous perennial: lvs. simple, or pinnate or rarely bipinnate, the lobes lanceolate or ovate-lanceolate: heads corymbose, the involucral bracts ciliate; petals whitish or yellowish, of medium size: achenes compressed, angular, the angles ciliate. Guatemala.—Hardy N. only with protection.

pilòsa, Linn. St. 2–5 ft. high, much branched, nearly glabrous: lvs. ternate or pinnate, divisions lanceolate, incised-serrate with somewhat rounded teeth: outer involucre about equaling the glabrous or minutely puberulent inner: rays short, 1–3 times as long as the involucre, creamy-white: achenes 4–7 lines long; awns 2–4, downwardly barbed, 1½ lines long. Tropics.—Sometimes grown in botanic gardens.

B. dahlioìdes, Wats. A perennial with dahlia-like tubers. Mex. G.C. III. 48:226. R.H. 1910, p. 475.

K. M. WIEGAND and N. TAYLOR.

BIENNIALS. Plants that bloom a year after the seeds are sown, then make seeds and die. Familiar examples among vegetables are cabbage, turnips, celery and onions, but in warm or long-season climates they become annuals. Even in northern gardens, celery, carrots and beets, if permitted to crowd, will often run to seed the first year. On the other hand, many biennials, such as hollyhocks and others, are practically perennial because they self-sow, or multiply by offshoots, so that there is little danger of losing them. Such cases give rise to discussion as to whether a plant is an annual, biennial, or perennial, but the practical problems are few and simple, and are commonly connected with the following favorite flowers:

Hollyhock (*Althæa rosea*), snapdragon (*Antirrhinum majus*), English daisy (*Bellis perennis*), Canterbury

bells (*Campanula Medium*), steeple bellflower (*Campanula pyramidalis*), sweet william (*Dianthus barbatus*), foxglove (*Digitalis purpurea*), horned poppy (*Glaucium luteum*), French honeysuckle (*Hedysarum coronarium*), morning campion (*Lychnis dioica*), evening campion (*Lychnis alba*), rose campion (*Lychnis Coronaria*), honesty (*Lunaria annua; L. biennis*), pansy (*Viola tricolor* ×) tufted pansies (*Viola cornuta* ×.)

Every beginner desires to know what to do with the seedlings that spring up in every border by the dozen or hundred around sweet williams, foxgloves, larkspurs, hollyhocks, and the like. All that is necessary is to thin the seedlings and transplant some at any convenient time before autumn to the positions in which they are to bloom next year. This practice, however, does not suit those who want only the finest varieties, for these do not come true from seed. Therefore, they must buy seeds every year of the best varieties of highly-bred groups, such as sweet william, foxglove, English daisy, Canterbury bells, and hollyhocks, or else buy plants. If a very fine variety appears, it is desirable to multiply it by methods other than seed-sowing if possible, e.g., by offsets, cuttings or division. Named larkspurs cannot be kept a long time, owing to disease, unless propagated by cuttings every year. Double hollyhocks can be maintained by division and by keeping the leaves coated constantly with ammoniacal copper carbonate, which is less unsightly than bordeaux. A German cultivator avers that one should save seeds from diseased hollyhock plants instead of healthy ones, and declares that he has raised 1,500 such seedlings that proved immune. So far as known, this has not been thoroughly tested in America.

Those who do not want such expense and care, and prefer lusty, many-flowered plants of ordinary varieties to sickly specimens of high-bred types, will find it cheaper and easier to collect seeds as they ripen and sow them immediately. Color discords can be mitigated by thinning out or transplanting offenders. This is the way to secure gorgeous masses of blue delphiniums, if one cares more for color than size and form.

What to do with famous English spring flowers that dislike our hot summers is another common problem. The beginner finds that violets, pansies, daisies, primroses, polyanthus, and auriculas, will not bloom all summer, as they do in the cool, moist climate of England, unless in similar climates (e.g., at the seashore or in the northern tier of states), and then only with special care in seed-picking, cutting-back, fertilizing, watering. At best the summer bloom is only intermittent, rarely massive, and the common practice is to treat these species frankly as spring bedding plants (April 15 to May 15 near New York), and when their glory is past discard them or move them to some moist, shady spot in which there is a better chance for casual summer bloom and a tolerable autumn show than in the hot sunny border.

Those who cannot afford greenhouses may easily have larger and better flowers of the species just named by the use of coldframes. They are particularly enjoyable while the snows of March are on the ground.

In these days of cheap greenhouses, everyone wants cut-flowers the year round, especially long-stemmed, long-lasting kinds in many colors. Consequently snapdragons and ten-weeks stocks have become popular.

The commonest way of raising biennials is to sow the seeds in an outdoor seed-bed in summer, and in autumn transplant the seedlings to their permanent quarters. English books have always disappointed Americans by advising that this be done in June. But in America the best time is early August. Not only does one save two months' care, but June-sown biennials and perennials in our climate make plants that are too large to winter easily in coldframes, and they often try to bloom just when the killing frost of autumn comes.

A much better way is to sow the seeds in flats in coldframes (for protection against summer showers) and to winter the young plants in frames. This is the way to secure the finest white foxgloves, Canterbury bells, larkspurs, and steeple bellflowers.

Professional gardeners often prefer to treat biennials as half-hardy annuals, i.e., they sow the seeds in greenhouses in March and set the young plants outdoors in May. On new places this saves a year; it is especially worth doing with snapdragons and intermediate stocks.

Many of the flowers named above are technically perennial, but in practice they are so short-lived that it usually pays to raise a fresh batch from seed every year.

WILHELM MILLER.

BIFRENÀRIA (Latin for *twice* and *strap*, referring to the two stalks of the pollinia). *Orchidàceæ*. Epiphytic plants, with pseudobulbs, plicate-veined lvs., and lateral infl.: fls. sometimes single and large, or more frequently smaller and several to many in a raceme; sepals about equal, spreading, the lateral adnate to the foot of the column; petals similar to the dorsal sepal; lip articulated to the apex of the column-foot, 3-lobed; pollinia 4, on 2 stalks.—About 25 species in Trop. Amer.

552. Bifrenaria Harrisoniæ. (×¼)

A. *Foot of column or mentum short and broad: fls. deep yellow with golden purple spots.*

aurantìaca, Lindl. Pseudobulbs ovoid, up to 1½ in. long: lvs. up to 8 in. long and 2 in. broad: raceme few- to several-fld.; fls. about 1 in. across, deep yellow and spotted with golden purple. Guiana and Trinidad. B.M. 3597. B.R. 1875.

AA. *Foot long, acute: fls. not colored as above.*

B. *Fls. large, 1–3.*

C. *Lip purple, darker-veined: fls. ivory-white.*

Hárrisoniæ, Reichb. f. Fig. 552. Pseudobulbs broadly ovoid, up to 2½ in. long, 1-lvd.: lvs. up to 1 ft. long and 4 in. broad: peduncle with 1 or 2 ivory-white large fls. about 3 in. across, the lip purple with darker veins. Brazil. Lind. 5:239. B.R. 897. B.M. 2927 (as Maxillaria).

CC. *Lip white, yellow or rose: fls. apple-green.*

inodòra, Lindl. Resembles *B. Harrisoniæ* in pseudobulbs, lvs., infl. and size of fls.: sepals apple-green; petals of the same color but brighter, smaller; lip white, yellow or rose; spur half as long as ovary. Brazil.

BB. *Fls. small, several.*

vitellìna, Lindl. Pseudobulbs ovoid, up to 1½ in. long, 1-lvd.: lvs. up to 1 ft. long and 1½ in. broad: fls. about 1 in. across, orange-yellow, with a purple spot on the lip; lip cordate. Brazil. B.R. 25:12. (As Maxillaria.)

B. bicornària, Reichb. Allied to B. aurantiaca. Fls. orange-colored. Brazil.—*B. Fuerstenbergiàna,* Schlecht. Fls. yellow. Brazil.—*B. melanópoda,* Klotzsch. Sepals and petals light green, lip fringed, white. Brazil.—*B. tetragòna,* Hort. Fls. wax-like with greenish sepals and petals. Brazil.—*B. tyrianthìna* var. *Goodsònæ,* Reichb. Fls. light purple.

GEORGE V. NASH.

BIGELÒVIA (after Dr. Jacob Bigelow, author of Florula Bostoniensis, Medical Botany of United States, etc.). Frequently written Bigelowia. *Compósitæ.* More than thirty species of western American herbs or low shrubs, one or two of which are sometimes offered by dealers in native plants.

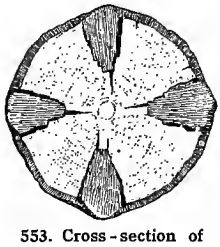
Heads 3–30-fld., without ray fls., small; involucre narrow, its bracts mostly lacking herbaceous tips. The only species in cult. is the one originally described, which resembles a goldenrod, to which Bigelovia is very closely related. It differs in not having the racemiform infl. of goldenrods. Prop. by cuttings and by seed.

gravèolens, Gray (*Bigelòwia dracunculoìdes,* DC.). Low shrub, 1–3 ft. high, densely white-tomentose when young, smoother in age, much branched, very leafy, malodorous only in drying: lvs. linear, 1–2 in. long: fl.-heads yellow, 5–8 lines high, very numerous, crowded, in terminal corymbose cymes, rayless. Alkaline soils Dak. to B. C. and south to S. Calif. and Ariz.—An extremely variable species. Var. **albicaùlis** is more permanently and densely woolly, dwarfer, and has been recommended in the West for low hedges and edgings. N. TAYLOR.†

BIGNAY: *Antidesma.*

BIGNÒNIA (The Abbé Jean Paul Bignon, 1662–1743, Court librarian to Louis XIV). *Bignoniàceæ.* Woody tendril-climbers, grown in the open in the warmer parts and also under glass.

Leaves opposite, compound (in proper representatives of the genus), the terminal lft. often represented by a tendril: fls. large, tubular or bell-shaped, enlarged above the calyx, obtusely 5-lobed, and more or less 2-lipped, the calyx slightly or not at all toothed; stamens 4, paired, and sometimes a sterile rudiment: fr. a 2-celled septifragal caps. flattened parallel with the partition; valves thickened; seeds winged.—The genus Bignonia is variously understood. By Bentham & Hooker it is regarded as a polymorphous group of 150 or more species; by Schumann (in Engler & Prantl) it is reduced to 2 species with claw-like (not disk-bearing) tendrils, *B. exoleta,* Vell., and *B. Unguis-cati,* Linn. By the former authors Bignoniaceæ is held to contain about 50 genera, and by the latter about 100. Schumann distributes the bignonias of Bentham & Hooker into several genera: the common East American *B. capreolata* goes to Doxantha, a disposition that has not been accepted by American botanists. As here employed, Bignonia is deprived of many of the tropical species that have been placed in it in horticultural literature, and the student is referred to Clytostoma, Cydista, Phædranthus, Pithecoctenium, Pyrostegia, Tabebuia and others. Very recently the name Bignonia has been used for the species described in this work under Campsis, because Bignonia originally was based mainly on *B. radicans* = *Campsis radicans.* In this case, the generic name for *B. exoleta* and *B. Unguis-cati* above becomes *Doxantha;* otherwise, this latter name remains a synonym of Bignonia, although, as stated above, Schumann has used it as the generic name of *B. capreolata;* but the correct name for this plant appears to be *Anisostichus capreolata,* of Bureau. The other species described here under Bignonia probably belong to different genera, but their correct botanical affinity has not yet been ascertained.



553. Cross-section of stem of a tropical climber of the bignonia family.

The bignonias are American climbers, mostly tropical, some of them and their allies constituting lianas of great length; and the profusion and beauty of their flowers makes them conspicuous and interesting. The stem of some species shows a 4-parted or cross-like arrangement in cross-section, whence the name "cross-vine;" and on this account, some of the natives of Spanish America attribute sacred virtues or attributes to the plants, calling them "bejucos de la cruz." Fig. 553.

The bignonias (using the term in the horticultural sense) are strong and rapid-growing evergreen greenhouse climbers, requiring considerable space for their best development, such as the roof of a large conservatory, or the back wall of a lean-to greenhouse. If convenient, they should be planted out under the plant stage of the greenhouse, or otherwise in boxes placed on the stage. A box 5 feet by 1½ feet and 1 foot deep will be found a convenient size for them. As with most greenhouse climbing plants, the roots like considerable freedom; but with bignonias the roots must be somewhat restricted (though not to the limitations of a flower-pot), otherwise an immense growth and few flowers will be the result. They are not very fastidious as to soil. A good, fibrous loam, to which one-third well-decomposed cow or sheep manure has been added, suits them admirably. A winter temperature of 45° to 50°, with a gradual rise as the days lengthen, should be given them, admitting air freely whenever the weather is favorable. They like plenty of moisture at the roots—especially during the spring and summer (the growing season)—but perfect drainage should be insured, as the soil at no time must become saturated or sour. Except when in flower, a good syringing on all fine days will be very beneficial. They should also be sprayed once or twice a week with a moderately strong solution of kerosene emulsion, or kerosene and water, to keep them free from mealy-bug, as they are very subject to this pest. The vines should be trained so as to allow a free circulation of air among the branches for the purpose of ripening the wood, as upon this depends the assurance of flowers. All superfluous branches and weak shoots should be removed, and before the growing season begins all the branches should be shortened from 1 to 3 feet, according to their strength; this will throw the energy of the plant into the lateral buds, which will produce the flowering branches, providing the wood has been properly ripened the previous season.—Propagation is effected by cuttings taken in late spring and inserted in sand under a bell-glass, or in a propagating-box, in a warm temperature. Choose, if possible, stout, short-jointed lateral growths for the purpose. They must be carefully watered until rooted, which usually takes from six to ten weeks. (E. J. Canning.)

A. *Lvs. compound: fls. yellow or yellow-red.*

Chàmberlaynii, Sims (*Anemopæ̀gma racemòsum,* Mart.). Glabrous: lfts. ovate-acuminate, glabrous, shining above, paler beneath, more or less tapering at base: fls. tubular, contracted below, 3–4 in. long, the limb comparatively short and spreading, bright yellow; cluster many-fld. Brazil. B.M. 2148. F.S. 3:235. P.M. 14:3–4.—One of the freest and most beautiful tropical climbers, flowering well in a small house. Should be in all collections of tropical plants. This plant bears the name of Consul-General Chamberlayne, stationed about 100 years ago in Brazil. The genus Anemopægma is kept distinct by many.

Únguis-càti, Linn. (*B. Tweediàna,* Lindl., not Griseb.). Lvs. evergreen; lfts. 1 pair, lanceolate and pointed, cordate, 3 in. or less long, with 3-parted claw-like tendrils: fls. trumpet-shaped, 2 in. long, allamanda-like, tube clear bright yellow, upper surface of limb orange-yellow, and throat with orange lines, the limb of rounded, spreading lobes and from 2–4 in. across. Argentina. B.R. 26:45. Gn. 40:10.—Will stand a little frost if grown in the open in the S. *B. Tweediana,* Griseb., is a Macfadyena.

capreolàta, Linn. (*B. crucígera,* Linn., in part. *Anisóstichus capreolata,* Bur. *Doxántha capreolàta,* Miers). TRUMPET-FLOWER. CROSS-VINE. QUARTER-VINE. Climbing to great heights (often 50 ft. or more), glabrous, evergreen: lvs. stiffish, ending in a branched tendril that clings by small disks; lfts. stalked, oblong-acuminate, cordate, entire: fls. in many 2–5-fld. short-peduncled cymes, yellow-red and lighter within, tubular (2 in. long), with a stout limb. Native from Md. south and west, and often a pest in orchards, climbing on the trees. B.M. 864. Gng. 1:370–1.—Handsome vine for outdoor use. Good for covering walls. Sometimes grown in conservatories. Not hardy N., but will survive in Mass. as a creeping plant.

Var. **atrosanguínea,** Hook. f. (*B. atrosanguínea,* Hort.). Lvs. longer and narrower: fls. dark purple, the lobes short and triangular-ovate. B.M. 6501. F.R. 2:27.—Handsome.

AA. *Lvs. simple, opposite (horticultural names, plants evidently not of this genus: perhaps Tabebuias).*

magnífica, Bull. Free-growing and floriferous, needing warm treatment: lvs. ovate-elliptic, stalked, entire: fls. panicled, large (3½ in. across), ranging from mauve to purple-red, the throat primrose, limb wide-spreading. Colombia. G.C. II. 12:73.—Requires hot sunny position under tropical conditions.

regàlis, Hort. Lvs. elliptic-lanceolate: fls. large, yellow and red. Guiana.—Requires warm treatment.

argỳreo-violáscens, Hort. Lvs. ovate, cordate at base, short-stalked, purple when young, but becoming beautifully veined and blotched with white: fls. purple. S. Amer.(?). I.H. 13:469.

B. adenophýlla, Wall.=Heterophragma.—*B. æquinoctiàlis,* Linn.=Cydista.—*B. álba,* Hort.=Pithecoctenium.—*B. buccinatòria,* Mair.=Phædranthus.—*B. Cherère,* Lindl.=Phædranthus.—*B. chrysántha,* Hort.=Tabebuia.—*B. grandiflòra,* Thunb.=Campsis.—*B. jasminoìdes,* A. Cunn.=Pandorea.—*B. Lindleyi,* DC.=Clytostoma.—*B. littoràlis,* HBK. Hairy on branchlets: lfts. roundish-ovate, acuminate, hairy: fls. red, pubescent, funnel-shaped, in axillary panicles. Mex.—*B. pállida,* Lindl.=Tabebuia.—*B. pícta,* Lindl.=Clytostoma.—*B. purpùrea,* Hook.=Clytostoma.—*B. radícans,* Linn.=Campsis.—*B. rugòsa,* Hook. Hairy: lfts. 2, oblong-acuminate: fls. axillary, 2–2½ in. long, primrose-color, limb short. Venezuela. Probably a Macrodiscus. B.M. 7124.—*B. speciòsa,* Grah. =Clytostoma.—*B. suavèolens,* Thunb.=Stereospermum.—*B. Thúnbergii,* Hort.=Campsis.—*B. venùsta,* Ker=Pyrostegia. L. H. B.

BILIMBI: *Averrhoa.*

BILLARDIÈRA (after J. J. Labillardière, French botanist and traveler). *Pittosporàceæ.* Six or eight species of tender Australian undershrubs, with twining branches, and terminal flowers suitable for outdoor planting South and for growing under glass.

Leaves entire or sinuate, alternate: fls. solitary or 2–3 together, sometimes as many as 15, yellow, purple or rarely blue, showy in *B. longiflora:* fr. succulent or fleshy, edible in some species. Prop. by cuttings under a bell-jar or by seeds, which, at least in England, are produced freely in some of the species. *B. longiflora* and *B. scandens* are cult. abroad as greenhouse climbers. *B. cymosa* is cult. outdoors at Santa Barbara, Calif.

scándens, Smith. Fig. 554. Sts. twining, often extensively so: lvs. variable, ovate-lanceolate to linear, obtuse or with a recurved point, 1–2 in. long, entire or undulate: fls. solitary, rarely 2 together, greenish yellow, violet or purple. Sweet. Fl. Aust., pl. 54. B.M. 801. —Offered by Montarioso Nurseries, Santa Barbara, Calif.

cymòsa, F. Muell. Shrubby with the branches more or less twining: lvs. oblong or lanceolate, sessile or nearly so, 1–2 in. long, obtuse or acute: corymbs several-fld.; sepals usually lanceolate-subulate; petals 7–8 lines long, bluish or violet-purple.

longiflòra, Labill. Lvs. lanceolate, entire: fls. greenish yellow, often changing to purple, solitary; pedicels glabrous: berries blue. N. TAYLOR.

BILLBÈRGIA (for the Swedish botanist, J. G. Billberg). *Bromeliàceæ.* About forty tropical American evergreen epiphytal herbs, now much cultivated by amateurs and in fancy collections. A few kinds are well known to florists. A closely allied genus is Æchmea, which see for botanical differences.

The fls. are in a spike or spicate panicle, which rises from the center of the rosette of long, spiny-edged, and usually stiff, pineapple-like lvs., showy, with 3-parted calyx and 3 long petals, 6 exserted stamens, thread-like style, and berry-like fr. The colored bracts of the fl.-clusters are usually very showy. Cf. Charles Mez, the latest monographer, in DC. Phaner. Monogr 9. Species confused: but the artificial arrangement given below may aid the gardener.

554. Billardiera scandens. (×¼)

Billbergias can be cultivated best in greenhouses, planted in pans, pots, wooden cribs, or wire baskets, with loose, light material about their roots, such as pieces of charcoal, roots of very fibrous plants, or fern roots and sphagnum moss, and such material. They demand little water at the roots in winter, and nothing but light sprinkling over the foliage is required to keep them alive during that time. But in summer, when the heat is great and they are making their growth, they can withstand an abundance of moisture at the roots as well as at the top, most of the time holding water in the funnel-like center or body of the plant. They usually produce their conspicuous showy bloom in the spring, when moisture overhead or sprinkling should be withheld in order to prolong the beauty of the flowers. They require at night a temperature of 50° to 75°, but, of course, can stand any amount of heat in summer. Billbergias, like all other bromeliads, make very good house plants, and they will thrive exceedingly well in a living-room temperature. They love plenty of light and sun. All first-class private garden establishments should have at least a few of this class of plants.—They are propagated best from suckers or sprouts, which arise from the base of the old plant, usually after it has bloomed and performed its functions. The old plant then gradually deteriorates, sending out two to five young plants from its base. These can be taken off as soon as they are hardy and substantial enough, and can be mounted or potted into the same kind of material. Then, suspended in the greenhouse, conservatory, or window for an exhibition, they thrive best.—Besides their beautiful and attractive flowers, billbergias have very handsome foliage, which is of a tough and leathery texture. Billbergias, æchmeas, and the like, are natives of the tropics, and, therefore, require a warm temperature. Æchmeas are usually larger than billbergias and tillandsias. (H. A. Siebrecht.)

A. *Petals curling spirally after fl. expands.* (*Helicodea.*)

zebrìna, Lindl. (*Bromèlia zebrìna,* Herb. *Æchmèa zebrìna,* Hort.). St. very short, or none: lvs. sheathing, deep green, with blotches and zones of gray-white, strongly spine-margined: fl.-cluster loose, long and drooping; fls. green or yellow-green, the stamens becoming long-exserted; bracts salmon or rose, long-lanceolate. S. Amer. L.B.C. 20:1912. B.M. 2686.

decòra, Poepp. & Endl. (*Helicòdea Baraquiniàna,* Lem.). Differs from the last in having longer petals,

denser spikes and longer bracts: lvs. 8–10, from 1–2 ft. long, mealy, white-blotched and banded. Brazil. I.H. 11:421. B.M. 6937.

AA. *Petals not spirally twisting.*

B. *Infl. nodding.*

C. *Fls. in panicles.*

speciòsa, Thunb. (*B. amàna,* Lindl. *B. pállida,* Ker). Lvs. strap-shaped, connivent, and forming a tube at the base, 1–2 ft. long, somewhat spine-margined, green above and lepidote and somewhat striped on the back: fl.-cluster large and loose, drooping; bracts rose; fls. pale green or whitish, tipped with blue. Brazil. —An old and well-known species.

CC. *Fls. in racemes.*

nùtans, Wendl. Stemless, stoloniferous: lvs. linear and long-pointed, 1–2 ft., distantly small-toothed, finely striate on the back: fls. 4–8, in a loose, drooping raceme; petals green, blue-edged; bracts lanceolate, red. Brazil. B.M. 6423. Gn. 32, p. 107.

Morélii, Brongn. (*B. Moreliàna,* Hort. *B. Wétherellii,* Hook.). Lvs. short, 1–1½ ft., with few weak spines, wide, glabrous and green: fl.-cluster exserted and drooping, with showy, pointed red bracts, the rachis woolly; fls. with red sepals and purple-limbed petals. Brazil. B.M. 4835. J.F. 2, pl. 138.—Very showy.

BB. *Infl. erect.*

C. *Fls. red.*

thyrsoídea, Mart. Lvs. 1–2 ft., broad-ligulate, spine-margined, concave on upper surface, green above and paler beneath, abruptly acuminate: fl.-cluster shorter than lvs., farinaceous, densely red-bracted; fls. numerous, bright red, petals reflexing. Brazil. B.M. 4756. J.F. 3, pl. 267.—Showy. Runs into several varieties, some of them with purple-tipped fls. (as vars. **splèndida** and **fastuòsa,** André, R.H. 1883:300). *B. splèndens,* Hort., is evidently one of the forms. Species too near the next.

pyramidàlis, Lindl. (*Bromèlia pyramidàlis,* Sims. *B. Croyiàna,* De Jonghe). A foot high: differs from the last in having more gradually acuminate lvs., which are more strongly and distantly toothed and whitish, or even banded on the back: fl.-cluster less farinaceous, broader and looser, the fls. less numerous. Peru. B.M. 1732.

555. Billbergia vexillaria.

CC. *Fls. purple.*

vexillària, André. Fig. 555. Hybrid of *B. thyrsoidea* and *B. Morelii.* Fls. purple; lower bracts long-pointed and red; spike erect, exceeding the lvs. R.H. 1889:468.

vittàta, Brongn. (*B. Lèopoldii,* Hort., not Morr.). Vigorous, 2–3 ft.: lvs. long and large, concave above, recurved at the summit obtuse, or abruptly pointed, red-spined, cross-banded on the back: fl.-cluster loose and nodding, shorter than the lvs., red-bracted; fls. deep blue, with recurving limbs. Brazil. Gn. 32:106. R. H. 1869, p. 87.

Liboniàna, De Jonghe. Small, 1–1½ ft., producing runners: lvs long-linear or strap-shaped, spiny, very sharp-pointed, concave and green above and whitish-mealy below: fl.-cluster erect or nearly so, rather slender, the bracts not prominent; fls. with red sepals and erect blue petals. Brazil. B.M. 5090. F.S. 10:1048. J.F. 2, pl. 197.

In the American trade the following names have been used: *B. clavàta longifòlia,* once offered by Pitcher & Manda, is probably an Æchmea—*B. fasciàta*=Æchmea fasciata.—*B. máxima*=(?).—*B. ornàta*=(?).—*B. Quesneliàna*=Quesnelia.—*B. rhodocyànea*=Æchmea fasciata.—*B. stricta*=(?).

Any of the following may be expected to appear in the American trade at any time: *B. andegavénsis,* Hort., is B. thyrsoidea × Morellii: fls. red and blue.—*B. Bàkeri,* Morr. (B. pallescens, Baker). Fls. greenish, tipped purple. B.M. 6342.—*B. Breauteàna,* André (B. pallescens × vittata), has reddish, purple-limbed fls. R.H. 1885:300. —*B. Brùantii,* Hort. (B. Bakeri × decora). Fls. greenish, bracts red.—*B. Enderi,* Regel. Small: fls. very deep blue; bracts coral-red. Brazil.—*B. Forgetiàna,* Hort. Lvs. large with bands of white on a green ground. G.C. III. 33:258..—*B. iridifòlia,* Lindl. Fls. red and yellow, blue-tipped. Brazil. B.R. 1068.—*B. Lièbzei,* Morr. Fls. and bracts rose. Brazil.—*B. nóbilis,* Bull. Cat. Bracts cerise-carmine, petals green, curling spirally after flowering: lvs. barred.—Perhaps only a form of B. decora, Poepp. & Endl.—*B. Porteàna,* Brongn. Fls. green, the petals rolling spirally. Brazil. B.M. 6670.—*B. Sanderiàna,* Morr. Fls. green, tipped blue. Brazil.—*B. Saùndersii,* Bull. Fls. greenish, tipped blue: lvs. striking, green above, reddish beneath, white-blotched and red-spined. Brazil. Gt. 39:1316.

L. H. B.

BILSTED: *Liquidambar.*

GEORGE V. NASH.†

BÍLTIA: *Rhododendron Vaseyi.*

BINDWEED: Name applied to various twining weedy plants, particularly to various kinds of Convolvulus.

BIOPHÝTUM (life-plant, some of the species being sensitive to the touch). *Oxalidàceæ.* Oxalis-like perennial herbs, sometimes grown under glass as curiosities: lvs. abruptly pinnate, with many lfts.: valves of caps. separating to base. There are about 20 species in Trop. Asia, Afr. and Amer. **B. sensitìvum,** DC., with 6–15 pairs of lfts., has lvs. that contract at the touch: fls. small, yellow: 6 in. Generally spread in the tropics. B.R. 31:68 (as Oxalis). **B. Fóxii,** Sprague, is a recently described species from Peru, with st. 2 in. high and bearing 8 lvs. at the apex in a whorl: lfts. 3–6 pairs: fls. white.

BIÒTA: *Thuja.*

BIRCH: *Betula.*

BIRD CACTUS: *Pedilanthus.*

BIRD-OF-PARADISE FLOWER: *Strelitzia;* also *Cæsalpinia Gilliesii.*

BIRDS. The horticulturist has the opportunity to avail himself of a mighty band of helpers in the birds. It seems not to be understood that it is perfectly possible for a bird to be eating something useful to man at some particular moment, and at the same time to be spending by far the greater part of its time eating things that are harmful to man, for which service it should be carefully protected. Very thorough studies of the food of birds have proved that the great majority are helpful to one who raises crops. Most birds are beneficial most of the time, and very few have no redeeming traits in this regard. Moreover, if useful birds are protected at all times, so as to encourage the natural increase, they will do their part in an emergency, such as an invasion of insects. Aside from these economic reasons for bird-protection is the gain that comes from their presence as attractive and interesting objects in nature, as much to be desired as blossoms and gardens.

It is said that there is less need of birds now that insects are being destroyed by arsenical sprays. This is perhaps to some extent true, but even in fruit-plantations the birds are still effective; and there are hosts of insects that are not effectively held within bounds by the sprays. Spraying will never take the place of birds.

Protection of birds from their enemies.

Birds should be both protected and attracted. Men and boys with guns and sling-shots, cats, and the Eng-

lish or house sparrow are the most common enemies or destroyers of birds. The red squirrel, weasel, crow, and shrike are destroyers as well, but they seem to be regulated naturally, although frequently one may interfere to good effect, particularly in the case of squirrels in parks. But man, the cat and the English sparrow should be controlled. Our boys can be educated to protect the wild birds. It is being done in many homes and schools. As soon as a boy learns the interesting habits of the common birds he loses the desire to kill, and he prefers to protect and observe. A bluebird or wren nesting on the premises will do more than all the laws to correct the lawlessness of boys.

556. Pouring the food on the "food-tree."

Experience shows that one must deal with the house or English sparrow, if one is to win back our insect-eating birds in any great numbers. The increase of other birds is in inverse ratio to the decrease of English sparrows. However, not everyone should be allowed to take part in the warfare against them. Schoolboys and inexperienced men make too many mistakes in trying to destroy them and their nests; and the taking of the eggs from the nest seems too much like an outrage on the instinct of motherhood, to be tolerated. The English sparrows should be kept within bounds as to numbers. They can be kept in check by the use of poisoned grain in winter. Some persons object to this practice from sentimental reasons, but it is no worse to despatch house sparrows than mice, prairie dogs, insects or other pests; and if man does not keep the sparrows within limits, they will destroy or drive away other birds. A certain number of house sparrows is desirable in winter, particularly in towns where there are few other winter birds, but they should not be allowed to become nuisances. See page 507.

It has been estimated that a cat destroys on an average about fifty song birds in one season. A new attitude toward cats is needed. They should no more be allowed to roam at will than should chickens or goats. All cats away from home are trespassers, and should be so regarded; they should fall to the care of a bird-warden. Bird-killing cats should be destroyed or kept within doors.

557. The "food-stick."

To attract birds, it is of course necessary to win their confidence. They must feel comfortable and secure. They must be aided to live through severe winter weather, and they must have adequate nesting-places and drinking-places. Measures to secure these ends have been put to the test and found to be genuinely satisfactory.

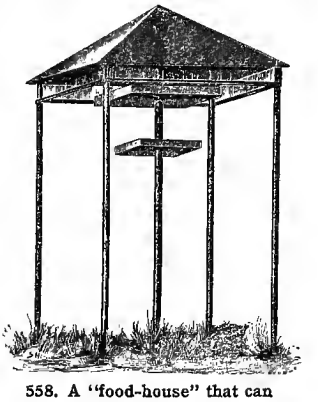
Feeding birds in winter.

Many birds perish for want of food in every severe winter. They digest their food so quickly that lack of it for a few days results in death. The real necessity is in the time of blizzards and continued cold, when they cannot find their natural food.

For insect-eating birds, suet and fat pork or a split bone may be fastened to the trunks of trees by means of wire netting and stout cord. Woodpeckers, nuthatches, and chickadees will be attracted. The netting prevents crows, jays and squirrels from carrying off the whole piece of food.

Seed-eating birds may be fed crumbs, nuts, millet, chaff, sunflower seeds, squash seeds, and various grains, including corn; also any kind of poultry-food, and even dog-biscuit. These materials may be placed on the ground after removing the snow, but should be protected to prevent waste. Many a bob-white has survived a heavy snowstorm by coming regularly to such a place. All kinds of sparrows, juncos, and snow buntings are among the birds that are attracted by such supplies.

Many ways for feeding birds near the residence have been more or less successful, depending largely on the prevalence of the English or house sparrows. The tree-shelf, window-shelf, moving shelf or counter, and the coconut filled with pork and kernels of nuts, are among the most useful devices.



558. A "food-house" that can be easily made.

In Germany, Baron von Berlepsch has experimented effectively in the winter-feeding of birds, with the idea of securing the protection of the food, and of making it accessible at all times to all birds. On his estate at Seebach he uses the "food-tree," the "food-stick," the "food-house" and the "food-bell," all of which were devised after many years of study of the habits of birds. The food-tree (Fig. 556) imitates a coniferous tree closely covered with insect eggs and larvæ. A mixture of hot liquid food which hardens as it cools is poured upon the tree. This food consists of white bread (dried and ground), meat (dried and ground), hemp, millet, sunflower seeds, and other seeds mixed with water. The food-tree is especially interesting to children and has brought good results in the study of winter birds. The food-stick (Fig. 557) is merely a part of a branch with six holes in which the food mixture is placed at intervals. The food-house (Fig. 558) is the most satisfactory of all ways of feeding. It consists of a roof on four corner posts with upper and lower food-tables, the lower being used only until the birds have discovered the upper table. Below the roof a strip of glass is fixed from post to post. This is very important to protect the food from the weather and also to admit light. The food-bell (Fig. 559) is a device for making hemp seed always accessible to the birds. It is very popular, except with the English sparrows. It may be placed on trees or buildings.

559. Section of "food-bell." *a*, food-dish; *b*, tube; *c*, food reservoir; *d*, metal bell.

Nesting-houses.

The birds that naturally make their nests in holes in trees are the ones that have been induced to build in artificial houses. Accordingly, the most successful houses are those that somewhat resemble a hollow limb, although great success has been attained with board houses, and other styles, as gourds, and coconuts, and even tin-cans. In fact, some bird will adapt itself to almost any kind of house, provided cats, red squirrels and English sparrows are kept away.

A most satisfactory cat-proof box for a bluebird can be made of weather-stained boards, if the following

precautions are taken: The hole should be well near the top with no perch near; the roof should slope from the back toward the front and should project about three inches. If the box is deep, the young bluebirds find it difficult to leave the house until they are strong and able to care for themselves, and this is a great advantage. The roof prevents rain from beating in, and keeps the cats out. From whatever direction the cat may attempt to reach the hole, the projecting roof stands in the way of reaching the nest. Twelve by 6 by 6 inches are good dimensions for such a house. It should be placed 8 to 15 feet above the ground.

560. The Hilbersdorfer foodhouse.

The house wren is the easiest of birds to attract. It will easily appropriate any little house if the English sparrow does not interfere. A good size is 7 by 5 by 5 inches, with the hole only as large as a 25-cent piece. It should be placed 6 to 8 feet from the ground, with the long axis of the box backward. The wren has the habit of filling the front of the house with sticks and leaving a hollow in the rear for the eggs. The hole should be in the upper half of the box. The middle of April is not too early to place it, in the northern states, although houses put out late may attract for the second brood. It is well to make the house so that it can be opened, to permit of its being cleaned for the second brood, for the wren will choose a clean house if it can find one.

The purple martin is an attractive neighbor. Unlike the wrens, which will not nest near one another, the martins are gregarious, so that the houses should have a number of compartments, each part 9 by 11 inches, with entrance 2¾ inches across. The house should be placed 15 to 20 feet above the ground. To prevent English sparrows from building before the martin arrives in the spring, the openings should be covered until April; or better, the house may be taken down in the fall and put up again in April.

561. Berlepsch Nesting-box.

562. Longitudinal section of Berlepsch's nesting-box.

Woodpeckers may be induced to live in houses. The opening should always be circular and with an upward slant; the bottom of the nesting cavity should be gourd-shaped and end in a pointed trough within which a few shavings are placed; and the inner walls should be roughened somewhat to allow the young birds to cling more easily. Of the 10,000 or more of these houses tried in parts of Germany, more than 90 per cent are occupied.

Drinking- and bathing-places for birds.

Birds need free access to water. If a brook or pond is near by, no more is necessary; but, otherwise, special provision should be made. The presence of water is a great factor in inducing birds to nest in a given locality.

There are many kinds of bird-fountains, but the chief characteristics are that the water be shallow, that the edge of the container be not slippery, and that they be placed where there are no hiding-places for cats. Most interesting styles have been devised, varying from constructions of natural rocks holding little pools, with wild flowers and ferns close by, to those made of flowerpot saucers, or of special pans, placed safe from molestation. School children are readily interested in the placing of bird-fountains and in watching the birds that come to drink and to bathe.

Nesting-places for birds that build in the open.

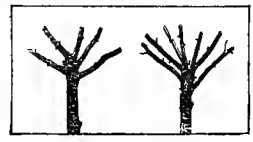
Birds breeding in the open nest in bushes and trees and on the ground, and among reeds or in banks. These comprise by far the larger class, and yet these birds are finding it more and more difficult to secure nesting-places. One cuts off hedges along roads and fences, cleans the pastures and meaddows, digs away the banks and seals up the roofs of barns with little thought of the birds that would like to nest there.

563. Nesting-box.

While all trees provide more or less shelter for birds, the conifers are most useful for this purpose. It is practicable so to plant as to have wild fruits for birds at all times of the year, and especially in cold winter days, and perhaps during the time in which one wishes to protect cultivated fruits. It seems to be agreed that the best single tree is the mulberry, either the white or the Russian. The fruiting season is long, and the trees are easily grown. Four good plants are: early sweet cherry, Juneberry or shadbush, mulberry, Virginia creeper. Probably more birds visit these plants than any others. Many other shrubs and herbs are of great value, as elder, black cherry, raspberry, blueberry, dogwood, pokeberry, and mountain-ash. Many growers protect their cherries and strawberries with mulberry and shadbush; or they plant a sweet early variety of the given fruit, to be left unpicked especially for the birds. Elder, Virginia creeper, and black cherry will serve as protectors for grapes. Raspberries and blackberries may be protected by mulberry, chokecherry, and elder.

564. Nesting-box.

Germany recognizes Seebach as the great bird experiment station. Representatives of many states and countries have visited the place, making effective observations of methods. For these students, special winter courses in bird-protection have been arranged, including not only theory but practical instruction. They find many acres of wood, thicket, and park made attractive to birds, with luxuriant undergrowth about the trees, special care as to the species, the shrubs specially pruned (Figs. 565, 566); hundreds of nesting-houses; food-houses and food-bells in various situations for winter-feeding. In the spring of 1905, the trees of the Hainich wood, south of Seebach, were stripped bare by the larva of a little moth (*Tortrix viridana*), whereas the wood at Seebach with its nesting-boxes was untouched. At a distance of a little more than a quarter of a mile the first traces of the plague were apparent.



565. One-year-old whorls recently pruned, to provide nesting places.

566. Old whorls recently pruned.

THE ECONOMIC IMPORTANCE OF FAMILIAR BIRDS.

Woodpeckers are especially fitted for the care of trees. The downy is the most useful woodpecker. It is the bird of the old orchard, preferring neglected trees, under the scales of which the codling-moth larva lies during the winter. It has been known to visit as many as 181 woodland trees between 9:40 A.M. and 12:15 P.M., making, meanwhile, twenty-six excavatione for food, most of

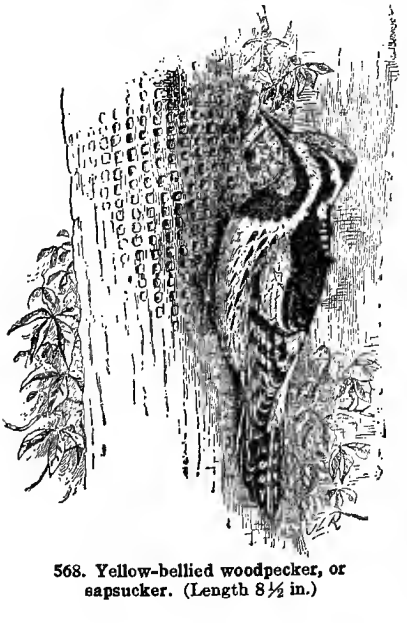
which exposed galleries of wood-boring ants. The hairy woodpecker (Fig. 567) is equal to the downy in importance, being fond of wood-boring beetles and wood-boring ants. Its large size and strong beak give it much power in drilling deep. A few ears of corn and a little suet will attract him. He is becoming less common than the other woodpeckers. The flicker is much misunderstood. Ants constitute about 40 per cent of his food, and he eats, also, many beetles, grasshoppers, and caterpillars, besides some wild fruit. The red-headed woodpecker is especially fond of beech-nuts and acorns. It stores them for winter use. In its storehouse are often to be found quantities of dried grasshoppers also. It is an irregular permanent resident in the East, but in the West it migrates regularly. The yellow-bellied sapsucker (Fig. 568) doubtless does considerable harm; in fact, it is responsible for most of the objections to woodpeckers in general. Whether the good done in destroying insects in the breeding season balances the harm done in sucking sap is an open question. The sapsucker drills holes in the trunks of many of the most valuable trees, as sugar maple, birch, pignut hickory, pine, apple, mountain-ash, beech, and others. The death of the trees may result not only from the loss of sap, but from the work of borers that deposit eggs in the holes. If the sapsuckers are to be destroyed, care must be taken not to kill the downy woodpecker at the same time. Fortunately, the sapsuckers are resident in fruit sections for only a short time in the spring and autumn. In their northern breeding-grounds they destroy many noxious insects. The red-bellied woodpecker annoys growers of Florida by its fondness for orange juice. Elsewhere it is of much value as a destroyer of ants and beetles and other insects.

567. Hairy woodpecker. (Length 9 in.)

The chickadee is a permanent resident. Many other birds seek their company, so that one has but to follow them as they rove to find many smaller birds. This is particularly true in spring and fall, when the warblers are in migration. In an experiment in Massachusetts, chickadees were attracted to an orchard in the winter by means of suet fastened to the trees. The birds destroyed multitudes of eggs of the fall canker-worm moth. The conclusion was reached that one chickadee would destroy in one day 5,550 eggs; and in the twenty-five days during which the canker-worm moths crawl up the trees 138,750 eggs might be taken by one chickadee. Chickadees readily accept a nesting-box.

The white-breasted nuthatch is the constant companion of the chickadee and the downy woodpecker. It takes from the bark great numbers of eggs of canker-worms, and many of the oyster-shell bark-louse, and even the hairy caterpillars of the gypsy moth. It is easily attracted by suet and will often eat crumbs as well. The red-breasted nuthatch, a smaller bird with dull reddish breast, comes from the North in September, spending the winter in attending to tree-trunks, and returning North in the spring.

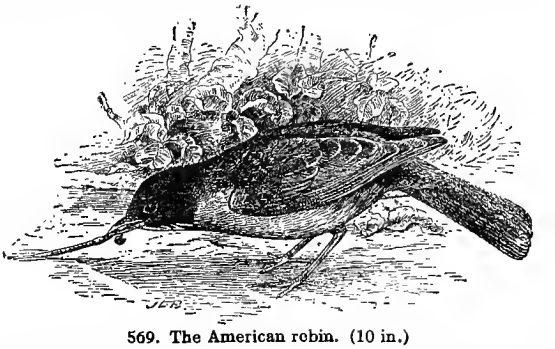
The brown creeper, with its long curved beak, rounded back, and stiff tail, is especially valuable for service among shade trees. It starts at the base of the trunk, ascending spirally, quietly investigating crevices as it goes.



568. Yellow-bellied woodpecker, or sapsucker. (Length 8½ in.)

The slate-colored junco, or snowbird, comes from the North in autumn and remains all winter, busy all the time in reducing the number of weed-seeds. The snowbirds rove in little flocks, and easily respond to seeds and crumbs put in any open place. In the North the junco destroys many insects, for the young eat insect food only.

The American robin (Fig. 569), (which is a very different bird from the robin of Europe), is protected by law in all of the United States excepting seven of the southern states. The National Association of Audubon Societies is making efforts to secure the passage of laws better calculated to protect it. An examination of the stomachs of 330 robins showed that vegetable food constituted about 58 per cent of the contents. Of this, 47 per cent was wild fruit, with only a little over 4 per cent cultivated fruit. The United States Department of Agriculture has shown by recent investigation that in the South the robin is essentially an insect-eating bird. The robin is the great enemy of the white grub, the young of the May-beetle or June-bug. The robin is an inveterate devourer of earth-worms in spring. Although the earthworm is useful to the soil, if it were allowed to increase naturally, with no interference by the birds, it would rapidly become a pest. The favorite food of young robins is the cutworm, and this is important, since there are frequently two or three broods of robins in a season and a young robin's appetite is nearly insatiable. The cutworm feeds at night and is going back to its hole at daybreak, when the robin intercepts it. One may prevent the robin from eating cherries by planting trees that are in fruit at the same time, as the Russian mulberry, and the shadbush and wild cherries, or even a cheap variety of cherry. The strawberry-grower may plant a variety of inferior strawberries to attract the robins from his choice fruit.



569. The American robin. (10 in.)

The bluebird (Fig. 570) destroys quantities of cutworms and other caterpillars. In August and September grasshoppers constitute more than 60 per cent of its food. It is fond of wild fruit, especially berries. Unfortunately, the bluebird is becoming uncommon.

The sparrows are among the most valuable birds to the farmer. The food of the native sparrows, as a family, consists of 25 to 35 per cent of vegetable matter, and 65 to 75 per cent animal matter. Young sparrows are almost entirely insectivorous until they leave the nest. Many sparrows rear two broods in a season. As soon as the insect season is over, they turn their attention to weed-seeds, of which Beal estimates that tree sparrows alone eat 875 tons in one season; and even this estimate may be too low. Forbush found, among other things, that a song sparrow, even after it had been eating seeds for about an hour before he began to count, ate 154 seeds in ten minutes and forty-five seconds. Song sparrows eat the seeds of such troublesome things as chickweed, purslane, sorrel, dandelion, and dock; also pests like plant-lice and cutworms, and caterpillars of the brown-tail and gypsy moths. The field sparrow (Fig. 571) is smaller than the song sparrow and very shy. It scarcely comes into our towns, but its clear trill from the fields suggests the warm days of late spring and early summer. It has been seen to eat May-beetles, leaf-hoppers, saw-flies, spiders, ants, and some earthworms. In the field it prefers weed-seed to grain. The chipping sparrow has the distinction of being the most useful sparrow, having an astonishing list of services to its credit. In the spring it feeds largely upon small caterpillars, as the gypsy, brown-tail, and tussock moths. It destoys at least three species of caterpillars on the cabbage; it is fond of wild cherries, chickweed seeds and seeds of ragweed, smartweed and many other weeds, including dandelions and the crab-grass of the lawn. The vesper sparrow is nearly as abundant as the song sparrow. It eats quantities of grasshoppers and beetles and weed-seeds. The English sparrow was introduced into the United States in 1850 for the purpose of destroying cankerworms and other insects just then becoming numerous. At first it was received with delight. A very short time, however, showed conclusively that it did more harm than good, and now every locality has its "sparrow problem." The charges against the English sparrow are serious. An investigation in Illinois showed that out of twenty-five stomachs of English sparrows at a time when 30 per cent of the food of the robin, 30 per cent of the food of the catbird, and 90 per cent of that of the bluebird consisted of insects, no insects were found in these sparrows, excepting traces of grasshoppers making perhaps 6 per cent of the food. However, during the first sixteen days of the nestlings' life, 40 per cent of the food consists of caterpillars, 10 per cent of beetles, and 40 per cent of small grains. This is perhaps the best that can be said for the English sparrow. It is so pugnacious that it has driven most of the bluebirds, wrens, and purple martins from the towns, while they themselves do not eat the insects that these birds would eat. Organized warfare against them has been more or less successful. But to

570. Bluebird. (7 in.)

allow the public in general to attempt destroying the nests, poisoning them or shooting them, is running a great risk in the use of guns and poison; and to offer prizes for their nests and eggs is sure to result in the destruction of many nests of valuable sparrows. This work should be done systematically by specially appointed persons at the public expense. In some European cities, there is an official known as the "Sparrow Warden," whose duty it is to proceed energetically against the sparrows.

The house finch, or linnet, has been the source of much complaint on the part of the fruit-growers of California, so that the investigations of the Biological Survey were of great interest. It appears that its claim to protection is in its enormous consumption of the seeds of weeds, as well as for its esthetic value,—for it certainly is a trim little bird and a good singer. Inasmuch as the linnet's food has been proved to be 86.2 per cent weed-seeds, and since examination of the contents of many stomachs shows that fruit is far from being its principal article of diet, many Californians protect the bird and plant shrubs and trees to attract them away from the fruit. These birds are fond of elderberries and many other wild fruits.

571. Field sparrow. (5½ in.)

The cedar waxwings or cherry-birds (Fig. 572), go in small flocks in search of food. Their fondness for cedar berries has given them their name, although they have a wide range of food. In early summer they feed almost exclusively on insects and become expert fly-catchers. Unfortunately, they have a bad reputation among fruit-growers because of their fondness for cherries. It has been shown, however, that they abundantly pay for the cherries taken. From an orchard infested with canker-worms, the stomachs of seven cedar-birds were examined, all of which were full of worms, averaging 100 to each. It was estimated that this flock would destroy 90,000 of the pests if they stayed in the orchard a month. At Washington, 152 stomachs of cedar-birds were examined showing that 74 per cent of the food consisted of wild fruits, 13 per cent of cultivated fruits, 5 per cent of which was cherries. The remainder consisted of grasshoppers, bark-lice, and beetles, among them the elm-leaf beetle.

The Carolina wren adapts itself to civilized conditions, and often nests about houses and farm buildings, as well as in old logs and tree-trunks. It is an eminently useful species, destroying great numbers of beetles, ants, weevils, especially the boll-weevil, which it destroys during its period of hibernation. Like its relative, the house wren, it may be attracted by nesting-houses. It is not migratory and may be heard all the year round from the Gulf north to Connecticut and Illinois. The house wren (Fig. 573) will occupy almost any little box, provided it be water-tight. The English sparrow will do its best to drive the wren away, but with a small opening the wren is safe and will usually win in the contest. The diet of the wren is mainly insectivorous, consisting of grasshoppers, ants, beetles, grubs, spiders, and hairy caterpillars. Many a fruit tree has been saved from the ravages of the tussock moth caterpillar by a family of wrens in the vicinity. Wrens gather spiders' egg-sacs full of eggs, putting them inside the house on the wall, ready for the first meal of the young birds.

The catbird (Fig. 574) is fond of fruit. The robin is often blamed for the deeds of the catbird. Inasmuch as the nestlings eat 95 per cent animal food, mainly insects and spiders, it is far better to plant fruit trees especially for the catbirds than to destroy them on account of their fruit-eating habits. In case of insect outbreaks, the catbird attacks gypsy, brown-tail, canker-worm, and tent-caterpillars.

572. Cedar-bird, or cedar waxwing. (Length 7 in.)

The attacks that the Baltimore oriole makes on the cherries, grapes, and the pea-pods, are more than paid for by its destruction of insects. Tent-caterpillars and other hairy larvæ that many other birds will not touch are eagerly eaten by it. The oriole does not swallow the whole caterpillar, but carefully removes a small portion of the inside. The orchard oriole is a related bird. Investigations in the cotton fields of Texas and Louisiana show that nearly a third of the specimens examined contained remains of the cotton-boll-weevil. Like the Baltimore oriole, it is mainly insectivorous in its diet and destroys a great many injurious species.

Blackbirds are of several kinds. The purple grackle and the bronzed grackle are together known as crow blackbirds (Fig. 575). Their food has been thoroughly studied. An examination of 2,258 stomachs showed that corn is consumed every month. At the same time, were found insects, spiders, myriapods, crawfish, earthworms, sow-bugs, hairsnakes, snails, fishes, tree-toads, salamanders, lizards, snakes, birds' eggs, and mice. Of the 48 per cent of animal food, 46 per cent consisted of insects. Of these, beetles were present in the greatest numbers. Many stomachs were crammed with large white beetle grubs. Often more than thirty grasshoppers were found in a single bird. Young blackbirds are fed on insect food entirely. They flock to caterpillar outbreaks. Many cases are reported in which fields have been entirely freed of sudden growths of grasshoppers and crickets. The red-winged blackbird has a bad reputation and is unprotected in many states. These birds appear early in the spring and remain late in the fall. They feed their young on insect food. Examinations of the stomach contents of the adults show that about seven-eighths of the red-wing's diet is made up of noxious insects and weed-seeds. The slaughter of blackbirds that occurred in the West during the twelve years previous to 1877 was in reality a national loss. The cowbird was named from its habit of accompanying the cattle and eagerly picking up the insects which are started up as they feed. The cowbird's food habits are on the whole beneficial, since it eats many insects and weed-seeds. The fact, however, that each young cowbird is raised at the expense of several more valuable birds (by appropriating their nests) makes it too costly. Brewer's blackbird is the western representative of the eastern rusty blackbird. Examination of 146 specimens gave the following facts: (1) Grasshoppers constitute more than half of its animal food; (2) more than 88 per cent of the vegetable food is grain, which is freely eaten at all seasons, even when insects are abundant; (3) seeds of harmful weeds are eaten sparingly. On the other hand, it does not attack fruit, which is an important point in a California bird. The yellow-headed blackbird, while wintering in the South, wanders over the country in quest of scattered and wild grain, weed-seeds, various insects, grubs and worms, and does little harm. In the spring, however, the birds congregate at their nesting-haunts and supplement their insect and waste-seed diet by various grains planted by the farmer of the Great Plains, and they are deservedly regarded as a great problem. In the plowing season, they follow the plow and greedily devour the earthworms and insects turned out, also the white grub, the cockchafer, and grasshoppers, the last forming a large part of the food of the young. So far as it has gone, the published work of the Biological Survey on the food of the yellow-headed blackbird, indicates that on the whole the good done by this bird somewhat overbalances the harm.

573. House wren. (4¾ in.)

The meadowlark destroys quantities of grasshoppers, cutworms, beetles, chinch-bugs, crane-flies, and "thousand-legs," where it takes only a few useful insects and a little scattered grain. In summer, 99 per cent of its food consists of insects, and in winter it takes many weed-seeds.

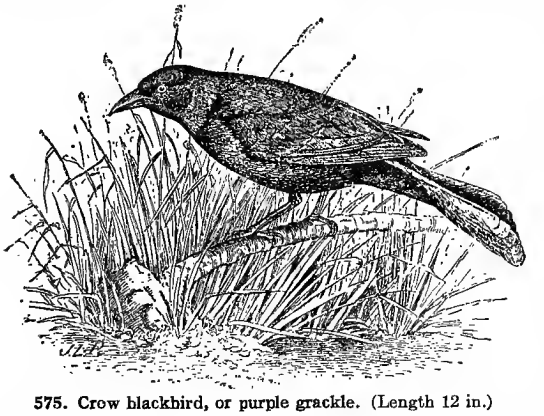
The kingbird (bee martin) (Fig. 576) is esteemed by agriculturists for its pugnacious disposition in driving off crows and hawks. Ninety per cent of its food consists of flying insects. It belongs to the family of flycatchers, of which the phœbe, the wood pewee and the great crested flycatcher are conspicuous members. They all obtain their food on the wing, darting out frequently from some chosen limb and back again. Bee-keepers have contended that the kingbird catches and kills honey-bees. In an investigation of 281 stomachs, only fourteen contained any remains of bees, fifty in all, of which forty were drones, four were workers, and six undetermined. At the same time, nineteen robber-flies were found, which more than compensated for the four workers. It is probable that kingbirds do eat a few bees, mostly drones, but they certainly also protect bees from insects that prey upon them.

Of swallows, there are five species in Eastern North America that one may expect to see: the barn swallow, the cliff swallow, bank swallow, tree swallow, and the purple martins. All of them do valuable work in clearing the air of insects, but the horticulturist will do well to encourage especially the purple martin. It feeds largely on some of the greatest pests: rose-beetles and May-beetles, the striped cucumber-beetle, as well as house-flies and flies that trouble cattle and horses.

574. Catbird. (Length 9 in.)

The blue jay (Fig. 577) has been shown by investigation to be beneficial as a rule, and that, except in cases in which it is discovered actually engaged in doing harm, it should be protected. Nearly 300 stomachs showed that the real food is composed of about 25 per cent animal matter, and about 75 per cent vegetable matter. The animal matter is chiefly insects, with a few spiders, myriapods, snails, fish, salamanders, tree frogs, mice, and birds. Remains of birds were found in only two out of 300 examined. Only three contained eggs of small birds. Apparently its nest-robbing propensities are not so general as is supposed. In August, the percentage of insects reaches 66 per cent. They prefer mast, or seeds of trees and shrubs, to corn or any other vegetable food. Corn is the only vegetable food of which the farmer suffers any loss, and here the damage is small. The California jay is a problem. Very careful and extensive investigations of the bird have resulted in the conviction that it has many more bad qualities than good. In fact, it has few redeeming virtues. Something may be said in his favor, from the esthetic side, as he is a handsome bird, and people interested in country life would no doubt miss his presence. Beal says that if they could be reduced to a fourth or a half of their present numbers, the remainder would probably do no serious harm. They eat very few insects, and destroy many eggs and young birds. They eat grain from the newly sown fields, but do not pull it up after it has sprouted, so that this is of minor importance. They are insatiable fruit thieves, not only eating enough for present need, but storing it away for future use.

The black-billed and yellow-billed cuckoos are valuable to the forester, orchardist, and the farmer. They feed mainly on the medium-sized and larger caterpillars and grasshoppers, as well as many other insects. In May and June, when the tent-caterpillars are defoliating forest trees, these insects constitute half of the cuckoo's food. One stomach was so full that the bird had evidently



575. Crow blackbird, or purple grackle. (Length 12 in.)

devoured the whole tent-colony. It is impossible to over-estimate the value of the cuckoo's work. The cuckoo of Europe is a bird of very different habits.

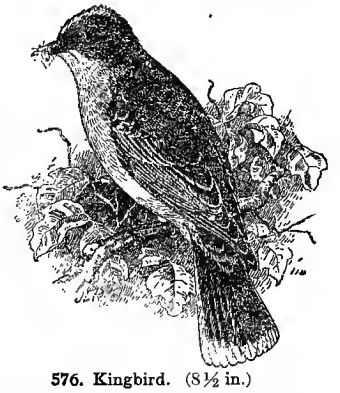
The common crow is a subject of much dispute. In a report of the United States Department of Agriculture, 1895, the evidence for and against the crow is clearly summarized as follows: (1) Crows seriously damage the corn crop and injure other farm crops, usually to a less extent; (2) they are very destructive to the eggs and young of domesticated fowls; (3) they do incalculable damage to the eggs and young of other birds; (4) they do much harm by the distribution of seeds of poison-ivy, poison sumach, and perhaps other noxious plants; (5) they do harm by the destruction of beneficial insects. On the other hand, they do much good: (1) By the destruction of injurious insects; (2) by the destruction of mice and other rodents; (3) they are valuable occasionally as scavengers. On the whole, it seems that the crow is not to be encouraged, although it need not be altogether exterminated.

The bobolink does nothing but good while it is feeding the young, insects forming about 85 per cent of the food. No fault can be found with him in the North, although he becomes a veritable pest in the South, destroying much rice. The annual slaughter of the "rice-birds" in the South accounts for the gradual decrease in numbers in New England.

An examination of eighty-two specimens of California thrasher shows that vegetable food exceeds the animal in the proportion of 59 to 41. Since it is eminently a bird of the ground, it is surprising to find that in addition to very many beetles, caterpillars, ants and spiders, a great number of bees and wasps were found in the food, also. There were many more wasps than bees. The vegetable food consisted of fruit, poison-oak seeds, and miscellaneous material. The thrasher must be added to the list of birds that assist in the dissemination of poisonous plants. It is not probable that the thrasher will ever become a resident of the orchard.

The western tanager, like the robin, sometimes becomes a nuisance in the orchard. It breeds north of the fruit-growing sections of California, but does injury to the cherry crop on its way north during the migration period. The investigation of the Biological Survey shows that it has a fair right to protection at the hands of the farmer, and even of the orchardist. It is suggested that wild cherry trees planted around cherry orchards may attract the birds away from the fruit.

The California bush-tit has been made the subject of special study. From 353 stomachs of bush-tits collected in every month, less than 1 per cent of the food was found to consist of fruit, and over four-fifths consisted of insects and spiders. The largest item was plant-lice, or bark-lice, or scale insects. Several stomachs were entirely filled with them. The stomachs of eight nestlings contained pupæ of the codlin-moth. It would probably be difficult to find a more valuable bird than the bush-tit. The birds live in flocks nearly nine months of the year.



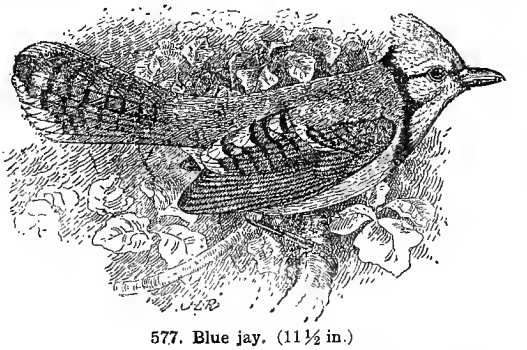
576. Kingbird. (8½ in.)

The black-headed grosbeak has been the subject of complaint by the Pacific coast fruit-growers, for it is fond of figs, cherries, and berries. However, it eats many insects that cost the horticulturists much annoyance. The codlin-moth, canker-worm, flower-beetles, and scale insects are among its favorites. An examination of 226 stomachs, the majority of which were collected in California, shows that during the six months of its stay in that state the bird consumes about 34 per cent of vegetable food, and 66 per cent of animal food, with a distinct preference for the black olive-scale, one of the most destructive insects of the coast. This insect alone constitutes a fifth of the entire food. To put it graphically, the black-headed grosbeak, for every quart of fruit eaten, eats more than three pints of black olive-scales, and more than a quart of flower-beetles, besides a generous supply of canker-worms and pupæ of codlin-moths.

The mourning dove has scarcely an equal as a weed-eradicator. The Biological Survey has shown that of 237 stomachs examined, over 99 per cent of the food consisted of seeds. Wheat, oats, rye, corn, barley, and buckwheat, were found in 150 of the stomachs and constituted about 32 per cent of the whole food. Three-fourths of this however, was waste grain picked up from the fields after the harvesting was over. Wheat was the favorite grain, and about the only one taken when in good condition. Corn, the second in amount, was damaged grain, taken after the harvest. The principal and almost constant diet, however, is weed-seed eaten at all seasons, constituting 64 per cent of the annual food-supply and showing little variation in any month. Three mourning doves which were examined had destroyed 23,000 prospective weeds. Yet they moved silently, and no one knew of their work.

The dickcissel, or black-throated bunting, is common in field and prairie in the Middle West, where its plaintive song gives variety to the silent days of July and August. Its food is more than half grasshoppers and crickets, and the remainder seeds of weeds and grasses. In some localities it is known as the "little meadowlark," its color being like that of the meadowlark, even to the black locket on a breast of brilliant yellow.

The cardinal and his mate are indeed a conspicuous pair. They are known as cardinal grosbeaks, redbirds, crested redbirds, and Virginia nightingales. They are most abundant in the southern United States, although frequent records show the limit of their range to be approximately a line drawn from New York City westward to southern Nebraska, and thence south to Texas. The cardinals' food is varied, consisting of seeds of numerous plants, especially those of rank weeds and grasses. The large and powerful beak readily breaks into large seeds, as corn, wheat, rye, and oats. It eats great quantities of adult beetles, especially rose-beetles; also crickets, grasshoppers, flies and ants. It enjoys grapes, berries,



577. Blue jay. (11½ in.)

mulberries, cedar-berries, preferring the wild varieties always. These habits, added to the striking beauty of its plumage and of its song, make the cardinal a great favorite.

The mockingbird is omnivorous. While investigating the feeding habit of this remarkable bird, Beal found that in fifty-two specimens 29 per cent of the food consisted of vegetable matter, of which 50 per cent was fruit. The birds' appetite for fruit and

berries in some communities becomes at times so marked that many fruit-growers complain, while others plant more fruit to provide enough for both man and bird. Besides fruit and berries, its food includes the seeds of dogwood, holly, red cedar, and pokeberry. It eats a great many noxious insects, including grasshoppers, beetles, cotton-worms and boll-weevils.

The bird pictures herewith are adapted from Farmers' Bulletin 54, U. S. Dept. Agric. on "Some Common Birds in Their Relation to Agriculture," by F. E. L. Beal. CORA A. SMITH.

BIRD'S-NEST FERN: *Thamnopteris.*

BIRD'S-TONGUE FLOWER: *Strelitzia.*

BIRTHWORT: *Aristolochia;* also *Trillium.*

BISCHÓFIA (for G. W. Bischoff, Professor at Heidelberg early in nineteenth century). *Euphorbiàceæ.* Ornamental tropical tree.

Lvs. alternate, trifoliate: calyx imbricate; ovules 2 in each cell. The one species is being used to some extent in recent years in the warmer parts of the U. S. It is said to grow freely in sandy soil.

trifoliàta, Hook. (*B. javánica,* Blume). TOOG. A fine tree, with bronze-green lvs.; lfts. stalked: sepals 5; petals none: fr. berry-like. Trop. Asia and Pacific Isls. Hook. Ic. Pl. II. 5:844. J. B. S. NORTON.

BISMÁRCKIA (in honor of Prince Bismarck). *Palmàceæ,* tribe *Borásseæ.* Sometimes referred to *Medemia.* A genus nearly related to Latania and distinguished by having only 6 stamens instead of many. Forms a tree 200 ft. high, with a gigantic crown of palmate lvs. with white-streaked petioles and blades 10 ft. in diam.: fr. borne in large, drooping clusters, dark brown, plum-like, 1½ in. diam., with a thin outer shell and a fibrous inner one inclosing a rounded, wrinkled seed 1 in. diam., reticulated like a walnut and ruminated as in the nutmeg. Cult. as for Latania, but the winter temperatures should be from 65–70° and summer temperature from 80–90°. G.C. II. 22:596.

nóbilis, Hildeb. & Wendl. In young plants petiole convex on the back, channelled above, finely serrate on the ridges above, thinly clothed with tufts of fibrous scales, half as long as the blade; blade blue-green, rigid, 3 ft. in diam.; segms. 20, 2 in. wide, 1 ft. long, apex blunt, obtuse, with a long curved filament from the base of each sinus. Madagascar. G.F. 6:246. F. R. 2:257. Gt. 1221. JARED G. SMITH. N. TAYLOR.†

BITTER-SWEET: *Solanum;* also *Celastrus.*

BÍXA (S. American name). *Bixàceæ.* A monotypic genus of tropical trees with large, entire lvs. and showy fls. in terminal panicles: lvs. entire, long-petioled, dotted: sepals 5, distinct, imbricate, deciduous, alternating with exterior glands; petals 5. *B. Orellana* is cult. in the E. and W. Indies for the annatto dye prepared from the orange-red pulp that covers the seeds. It is the coloring matter chiefly used in butter and cheese. It is also used in dyeing silks, and preparing chocolate.

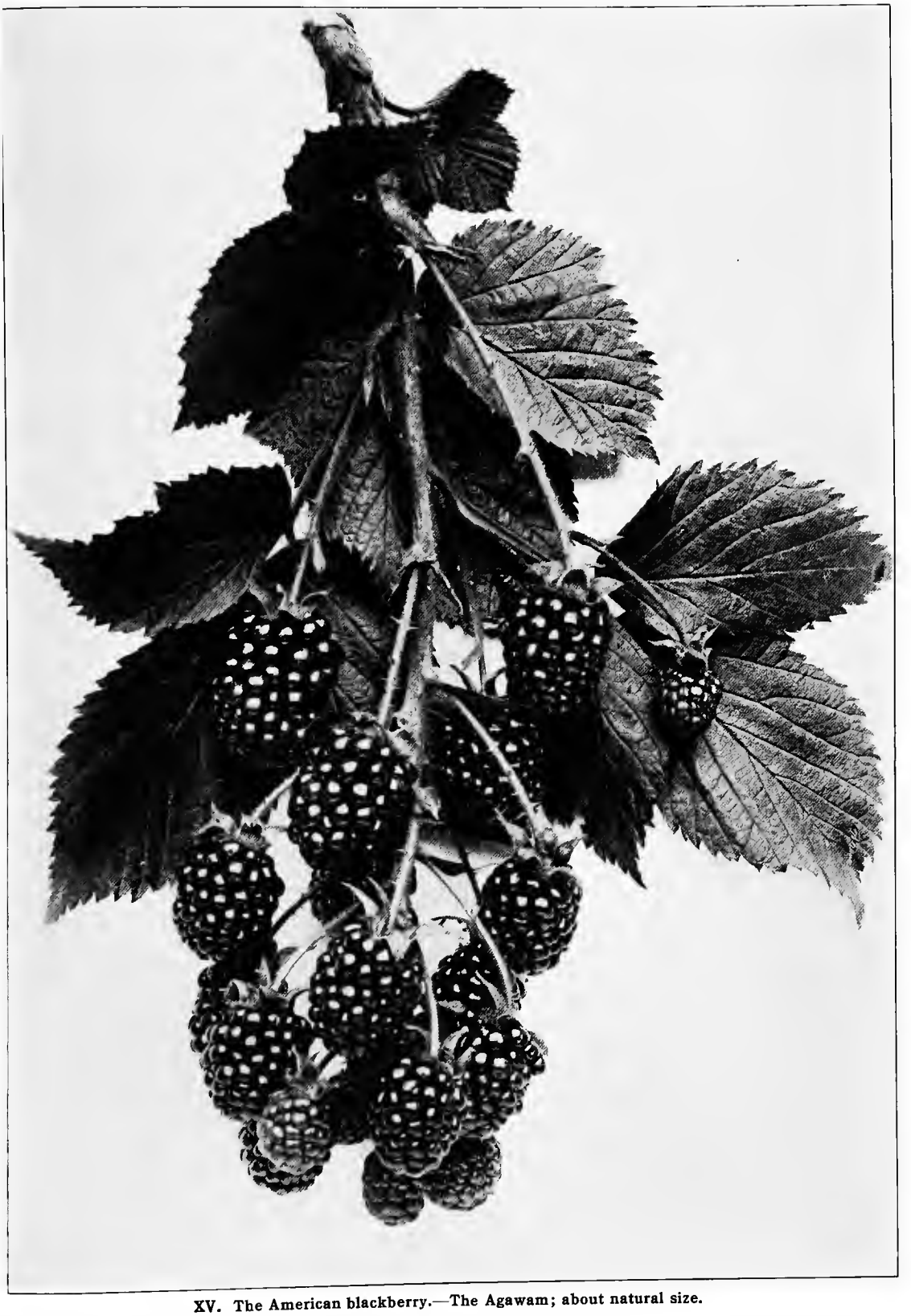
Orellàna, Linn. ANNATTO-TREE. Height 30 ft.: lvs. cordate: fls. pinkish or rose-color. B.M. 1456.—It is rarely grown in northern greenhouses as an ornamental. Cuttings taken from a flowering plant will produce flowering plants of a convenient size. Plants from seed usually flower less freely, and must attain a greater size before flowering. N. TAYLOR.†

BLACKBERRY. Cultivated blackberries are the progeny of several species of the genus Rubus. The common garden blackberries are all natives of America, while two little-known but quite distinct forms, the Oregon Evergreen, much grown on the Pacific coast for its fruit and as an ornamental, and the Himalaya, comparatively recently introduced in commercial plantations, come from the Old World. Blackberries are erect-growing perennial plants, bearing black or occasionally whitish fruits which do not separate from the juicy receptacle. Dewberries are distinguished from blackberries only in being procumbent plants, while raspberries differ chiefly in bearing variously colored fruits that fall from a dryish receptacle when ripe. Blackberries are now largely grown only in North America but they are being introduced in gardens in other parts of the world, from some of which, notably in New Zealand, they have escaped and have become troublesome field and roadside plants.

578. Wild Blackberry—Rubus allegheniensis. (×⅛)

The kinds.

There are many forms of blackberries, species, subspecies and varieties with many hybrids and intergradients abounding. At present it is impossible to group the forms with the expectation of a permanent classification. (For a botanical classification see *Rubus.*) The following is the common arrangement of the horticultural varieties (Bailey): (1) The Long-Cluster varieties are probably best known. These belong to *Rubus allegheniensis* (Fig. 578). The plants in this group are tall and shrubby with purple canes armed with stout, straight prickles. The fruits are sub-cylindric or thimble-shaped, sweet, dull-colored, with many small closely packed drupelets, and are borne, as the name implies, in long clusters. The White blackberry, having amber-colored fruit and rounder lighter-colored canes, is an albino form of the Long-Cluster blackberry. Taylor and Ancient Briton are the most prominent representatives of the Long-Cluster group, while Iceberg best represents the albino form. (2) Var. *sativus* furnishes a number of varieties roughly grouped by horticulturists as the Short-Cluster blackberries (Fig. 579). These are characterized by smaller and weaker plants than the preceding, with green and nearly unarmed canes, short, leafless clusters, composed of globose glossy berries of few, large, juicy, irregularly set drupelets. The varieties most commonly grown are Agawam, Kittatinny, Lawton and Snyder. (3) The Leafy-Cluster blackberries belong to a species doubtfully known as *R. argutus,* Link, and are characterized by low bushy plants bearing short clusters with leaves intermingled with the flowers. Here belong the old Dorchester, one of the first varieties cultivated, and Early Harvest, a valuable commercial sort. (4) The Loose-Cluster blackberries are probably hybrids (Fig. 580) between the first group named and the dewberry (*R. procumbens,* Muhl.). The plants are low and spreading, with broad, jagged notched leaves, short clusters of large, roundish berries with juicy, glossy, loosely set drupelets. Early Wilson and Wilson Junior are the best known varieties of this group. (5) The Sand blackberry (*R. cuneifolius,* Pursh) is the parent of a few unimportant sorts, of which Topsy or the Tree blackberry is the best known. The plants of this group are low and shrubby, with stout recurved prickles; the clusters bear from one to four roundish berries of loosely set drupelets (Fig. 581).



XV. The American blackberry.—The Agawam; about natural size.

(6) The Evergreen blackberries, of unknown origin, to which the Himalaya is closely related, are commonly put in *R. laciniatus*, Willd., but may be but a cut-leaved form of the European bramble (*R. fruticosus*, Linn.). The vines are clinging, the foliage evergreen or nearly so, and the berries in the Pacific coast climate are large, black, sweet, and ripen through a period of two or three months. The Oregon Evergreen is the typical variety.

Propagation.

In nature the blackberry propagates itself from suckers and under cultivation young plants from suckers are thriftiest, but many varieties produce but few suckers and the natural process is a slow one with all kinds. A more expeditious method is to use root-cuttings. Such cuttings are usually made during the dormant season by taking up old plants and cutting the roots with pruning-shears into parts 2 inches long. The cuttings are then started under glass, or sown in furrows in well-prepared nursery beds in the spring. The cuttings should fall in sowing 2 inches apart in furrows 3 inches deep and should be covered with well-pulverized soil. The soil must be such that it does not bake as the young shoots appear. It sometimes requires two summers to produce plants ready for setting, but in the South, the Pacific coast, and under favorable circumstances in the East, yearling plants are strong enough for setting. Cuttings should be made from the roots of thrifty, healthy plants, preferably from a young plantation. It is contended and there are many facts to substantiate it, that propagating successive generations of blackberries from root-cuttings results in unproductive or even sterile plants.

Some blackberries from the several varietal groups may be grown in almost every condition of climate and soil in temperate regions, yet this fruit does best in a carefully selected environment. Blackberries cannot stand, without protection, more winter cold than the peach. In dry, hot climates the plants suffer and the berries are few, small, poorly colored and lacking in flavor. A deep, mellow, clay loam, well filled with humus, is most suitable for this fruit. Gravelly and sandy lands are usually too hot and dry. Flat wet lands are quite unsuited and in such soils the plants suffer alike from cold and heat; whatever else may be said of the soil, good drainage is imperative. A northern exposure is usually desirable. Fertilizers are little needed if the land be rich enough naturally to grow fair farm crops. Stable manure often induces rank-growing canes which produce but little fruit. Cover-crops of vetch or clover and some grain as oats or barley, sown in August, will supply much-needed humus and about all the plant-food usually necessary to add.

579. The short-cluster garden blackberry. (×½)

Field cultivation.

The plants are set in rows, 7, 8, or 9 feet apart, depending on the soil and the variety, and from 3 to 4 feet apart in the row. There should be room between the rows for a two-horse harrow or cultivator to keep the plantation in good condition. Planting may be done by spade or in furrows 6 or 7 inches deep. A hoed-crop is usually grown between the rows the first year but seldom the second, as the plants need all the food and moisture to make sufficiently strong plants to bear a crop the third season. The canes are allowed to grow the first year to a height of 18 to 30 inches, when they should be cut back a few inches. The plants are thus pruned to cause them to grow low, stocky and upright, with many lateral branches, and so avoid the necessity of a trellis and yet be able to hold the crop up well. Trellising is troublesome and expensive.

Subsequent training and pruning consist in keeping the plants well branched, low and stocky, and in regulating the amount of bearing wood. Success in growing blackberries depends largely upon proper training and pruning. The fruit is borne upon one-year-old canes which should be removed as soon as the crop has been harvested. To allow them to stand through the growing season jeopardizes the proper development of the new canes, and often exposes them to infection from fungi. Five or six canes to the plant are quite enough; if there are more, the size and quality of the crop will be reduced. The canes should be headed-in annually during the growing season, as recommended for the first year. In the spring laterals are shortened-in, the amount of cutting-back depending upon how close the fruit is borne to the cane on the variety in hand. The laterals are usually left from 12 to 20 inches long. This spring pruning may be and often should be made a thinning process. Managed according to the directions just given, the plants need neither stakes nor trellises. In some plantations, however, a wire is stretched along each side of the row to hold the plants up, and in others, notably along the Hudson River, the plants are trained on two-wire trellises. In northern climates the training must be such as to provide for winter protection for many varieties.

Winter protection consists in laying down the canes and covering them wholly or in part with a thin mulch of straw or earth. The method of laying down must be varied with the variety, the soil and the amount of protection to be given. Three men can do the work most expeditiously; one goes ahead and digs the earth from the front and back of the roots, a second with fork or foot pushes the plant forward to the ground, the third puts on the mulch of earth or straw. Tender varieties are wholly covered, but the hardier sorts need only a covering on the tips of the canes. The plants are raised in the spring just before or as the buds begin to

burst. Care must be taken not to break or split the canes. Such protection at present prices of labor will cost from eight to twelve dollars per acre. Winter injury is sometimes a matter of moisture as well as of temperature, and, in irrigated regions, late irrigation may obviate the necessity of a winter covering.

Thorough cultivation is essential for the proper conservation of moisture in a blackberry plantation, abundant moisture being a prime requisite for this fruit. It must be frequent and constant until the berries begin to turn in color. After the crop is harvested, the cultivator should be used to put the ground in shape for the cover-crop. The cultivator must be shallow-cutting since deep cultivation injures the roots, thereby weakening the plants, and inducing suckering. Mulching to take the place of cultivation is not to be recommended, except in small patches, and in the row with cultivation between rows.

Blackberries should not be harvested until fully ripe, and the sooner eaten after picking the better the quality. The fruits are not ripe when they attain full color but must be left on the bushes until soft, at which time they should part from the stem readily when the cluster is shaken. In picking, the berries should not be exposed to the sun. Well treated, the plants should bear some fruit the second season, and the third summer should give a fair crop. The length of time the plants will bear depends upon the variety, the soil and the treatment. When the stools become thin, the canes weak and the fruits small, the plantation should be cut down, this time coming usually when the bushes are ten or twelve years old.

Blackberry-growers have several troubles to contend with. Late frosts occasionally do much harm in northern latitudes. Borers often do much damage to canes and can be circumvented only by cutting out infested stalks. Two fungous diseases, orange rust and anthracnose, are dangerous, and are successfully kept in check only by cutting out the diseased wood. Root-galls are often found but it is doubtful whether they do much damage, and it is certainly not worth while trying to control them. Good treatment, especially as regards cultivation and pruning, with careful attention to destroying the pests mentioned as soon as practicable, will keep the plants in health.

The yields and profits in blackberry-growing are most encouraging to small-fruit-growers. In a plantation well cared for, a crop of two hundred bushels per acre may be expected. Blackberries are not suitable for long-distance shipments and monetary rewards come from local markets and here they are often large when climate, soil and general conditions are favorable. U. P. HEDRICK.

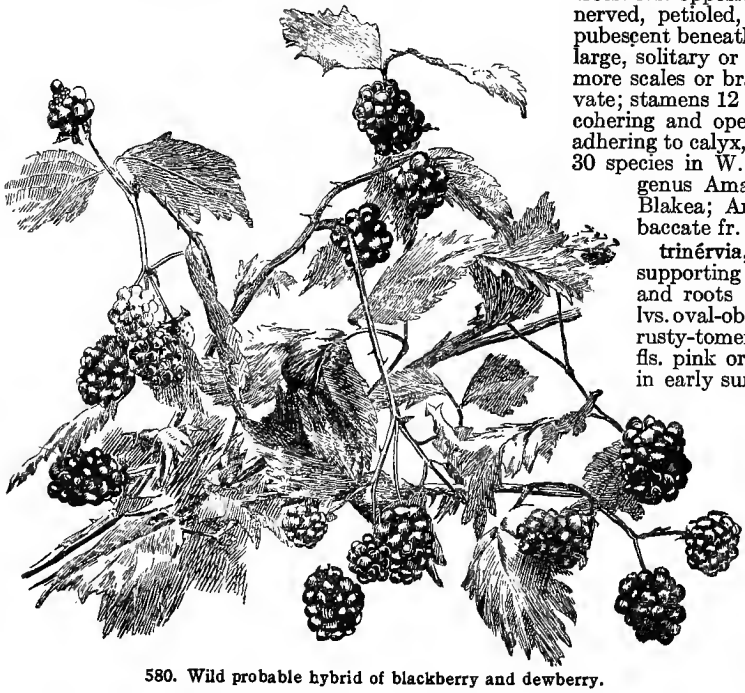
581. Sand blackberry. (×½)

BLACKBERRY LILY: *Belamcanda.*

BLACKWOOD: *Acacia.*

BLADDER-NUT: *Staphylea.*

BLADDERWORT: *Utricularia.*



580. Wild probable hybrid of blackberry and dewberry.

BLÀKEA (Stephen Blake, gardener, of the island of Antigua in the West Indies, who wrote "Compleat Gardener's Practice," London, 1664). *Valdesia*, Ruiz & Pav. *Melastomàceæ.* Hothouse or greenhouse evergreen shrubs, of which two species are in cultivation for the showy flowers and prominent foliage.

Erect or scandent woody plants, sometimes small trees: lvs. opposite, leathery, mostly prominently 3-7-nerved, petioled, nearly or quite entire, often rusty-pubescent beneath: fls. rose-purple or white, showy and large, solitary or fascicled in the axils; calyx with 4 or more scales or bracts at base; petals 6, oblong or obovate; stamens 12 with thickened filaments, the anthers cohering and opening by 2 pores at the apex; ovary adhering to calyx, 4–6-celled: fr. a fleshy berry.—About 30 species in W. Indies and S. Amer. By some the genus Amaraboya (which see) is included with Blakea; Amaraboya has capsular rather than baccate fr.

trinérvia, Linn. Shrub, in the wild the branches supporting themselves on neighboring bushes, and roots sometimes springing from the sts.: lvs. oval-oblong to elliptic, dark green above, often rusty-tomentose beneath, prominently 3-nerved: fls. pink or rose-color, solitary, on long stalks, in early summer. Mountain woods, Jamaica.—A good plant for the warm conservatory.

grácilis, Hemsl. Compact shrub, 2–3 ft.: lvs. elliptic, acuminate, leathery, glabrous: fls. solitary, fragrant, 2 in. across, the petals white with a rose-colored spot at the base. Costa Rica.—Needs an intermediate temperature. L. H. B.

BLANDFÒRDIA (after George, Marquis of Blandford). *Liliàceæ.* Tender rhizomatous plants from Australia and Tasmania, placed by

Baker (Jour. Linn. Soc. 11:364) between Kniphofia and Funkia; adapted to culture in greenhouses. Blandfordia of Andrews is a synonym of Galax.

Roots thickly fibrous: lvs. in two vertical ranks, narrowly linear, hard, persistent: fls. large, 1½–3 in. long, showy, nodding, in short racemes, usually orange-red to crimson, with yellow tips.—The authorities recognize only 4 botanical species, but those below are horticulturally distinct from one another.

Being tenderer than the poker plant, and of more difficult culture, blandfordias are rarely grown in America. *B. flammea* var. *princeps* is the best kind. In New South Wales they grow in peat bogs and on shady mountain sides. During the growing season they must be shaded from bright sunshine, and during the resting season they may be placed in a light pit, in which they are not crowded or shaded by taller plants. They like a moist atmosphere and plenty of air, but not draughts. The chief element of the potting soil should be peat; if the peat is heavy, use freely; if light, use some loam, and pack firmly; if spongy, add some charcoal. Pot after flowering, in early spring, being careful not to overpot, and plan to leave roots undisturbed for two years at least. A top-dressing each year and liquid manure during growing season, is necessary to produce a good flowering. Perfectly hardy in central Florida when grown in lath-houses.—Propagation is by seeds sown in sandy peat with mild bottom heat, or usually by careful and not too frequent divisions of the root, made in early spring, after flowering, at the time of repotting, and preferably when strong offsets are formed.

A. *Margin of lvs. not roughish.*

Cúnninghamii, Lindl. Lvs. 18–24 in. long, 3–4 lines wide, broader than in *B. flammea:* fls. 10–15, or even 20. Blue Mts. of Austral. B.M. 5734. Gn. 24:366.—This has been held to be synonymous with *B. grandiflora,* but it is horticulturally distinct, and the pedicels are shorter. Considered by Bentham the same as *B. grandiflora.*

AA. *Margin of lvs. roughish.*

B. *Fls. golden yellow, without any red.*

aûrea, Hook. f. Lvs. 8–12 in. long, 1½–2 lines wide: fls. 3–6, the only ones in the genus not touched with red; perianth wide-swelling, sometimes nearly as wide as long, more bell-shaped than any other species. New S. Wales. B.M. 5809.—By some considered a mere variety of *B. flammea.*

BB. *Fls. red-tubed and yellow-tipped.*

C. *Perianth long, 3–4 times as long as wide.*

nóbilis, Smith. Lvs. 12–18 in. long, ½–¾ lines wide, dark green, sharply 3-angled: fls. 4–9, smallest of the genus, and narrowest. Near Port Jackson. B.M. 2003. B.R. 286. Var. **imperiàlis,** Hort. Fls. bright orange-red, margined with yellow or gold; larger than the type.

flámmea, Lindl. Lvs. 12–18 in. long, 2–2½ lines wide: fls. 4–12, typically constricted near the base of the tube and much lower down than in *B. Cunninghamii.* E. Austral. B.M. 4819. P.M. 16:353. F.S. 6:585; 18:1829 (as *B. Cunninghamii*). Var. **prínceps,** Baker (*B. princeps,* W. G. Smith), has larger and brighter-colored fls. and is the best of the genus. The perianth is longer and less spreading than in the type, and swells very gradually from the base, instead of being constricted near the base. B.M. 6209. F.M. 1875:170. F.S. 22:2314. Gn. 47:324.

CC. *Tube short, scarcely twice as long as wide.*

grandiflòra, R. Br. Lvs. 12–18 in. long, 3–4½ lines wide: fls. 10–30. Distinguished from all others by having the filaments inserted instead of at the middle, but in var. **intermèdia,** Baker, which connects *B. grandiflora* and *B. nobilis,* the filaments are inserted at the middle of the tube, the lvs. are narrower, and the fls. smaller. Tasmania. B.R. 924.—The name *B. grandiflora* is now a misnomer, as the fls. are smaller than in any other species except *B. nobilis.*

B. cordàta, Andr.=Galax aphylla.

WILHELM MILLER.
N. TAYLOR.†

BLANKET FLOWER: *Gaillardia.*

BLAZING STAR: *Liatris;* also *Mentzelia.*

BLÉCHNUM (Greek name for some fern). *Polypodiàceæ.* Rather coarse greenhouse ferns, with pinnatifid or pinnate lvs., and rows of almost continuous sori parallel to the midvein and close to it, covered with a membranous indusium. Blechnum is here recognized as including the species sometimes classified under the generic name Lomaria in addition to those species which all writers agree to put in Blechnum. The differences on which Lomaria has been based are very slight and are not recognized by leading European fern students. Besides, if the species included in Lomaria are kept separate, it is practically certain that they must be classified under the older name Struthiopteris.

In Blechnum occurs a singular knot in nomenclature. Linnæus described two species in 1753, and to the West Indian one he gave the name *B. orientale,* citing figures, etc., showing that it is the plant that recent writers call *B. occidentale.* His East Indian plant he similarly called *B. occidentale.* The normal or ordinary usage has been followed below, the name *B. orientale* being given to the eastern plant.

582. Blechnum brasiliense.

Blechnums will thrive in almost any compost, but their leaves quickly turn brown and then black if watered overhead. Propagation of Blechnum is effected by spores.

Blechnums are very useful to florists for jardinieres, and for specimen ferns. To attain best results, it is necessary to maintain an abundance of moisture at the roots, with a drier atmosphere than most other ferns require, to prevent leaves from turning brown during winter months. Average temp. 60° to 65° F. Soil, equal parts of rich loam and leaf-mold or peat. The spores of most blechnums germinate very freely if sown on a compost of loam and leaf-mold or peat in equal parts, and placed in a moderately moist and shady position in a temperature of 60° to 65° F. Some of the species send out creeping rhizomes, which develop young plants at the ends. When of sufficient size these may be detached and potted, and in a short time they will develop into good specimens. Some very attractive species are found among the hardy British blechnums. (N. N. Bruckner.)

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A. *Fertile lvs. not strongly different from the sterile lvs.*

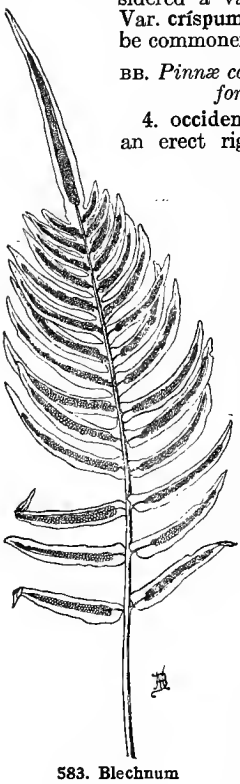
B. *Pinnæ strongly decurrent at the base, joining with the one next below.*

1. **brasiliénse,** Desv. Fig. 582. Growing from a stout, slightly arborescent trunk 1 ft. or more long: lvs.

2–3 ft. long, 1 ft. or more wide, with the pinnæ set at an acute angle with the rachis, the lower much shorter and more distant. Brazil. S. 2:4.—Rather tender in Cent. Fla. and needs protection during winter.

2. **nítidum,** Presl. Habit of *B. brasiliense,* but much smaller: lvs. pinnate; pinnæ oblong-falcate, thickish, 2–4 in. long, serrate. Brazil.—Plants 1–2 ft. high.

3. **corcovadénse,** Raddi. Pinnæ not cut to the rachis, much crowded and shorter than the last; longest pinnæ less than 6 in. long, attenuate at the tips; lvs. crimson when young, and gradually turning to a metallic hue before becoming permanently green. By some considered a variety of *B. brasiliense.* Brazil. Var. **crispum,** Hort., with wavy edges, may be commoner in cult. than the type.



583. Blechnum occidentale.

BB. *Pinnæ contracted at the base to the midrib, forming a very short stalk.*

4. **occidentâle,** Linn. Fig. 583. Lvs. from an erect rigid st., which is covered with brownish scales, 9–18 in. long, 4–6 in. wide, with the pinnæ truncate or even cordate at the base and slightly falcate. Mex. and W. Indies to Brazil.—A beautiful small fern.

5. **serrulâtum,** Rich. Growing from an ascending nearly naked rootstock: lvs. 1–2 ft. long, 6–15 in. wide, with numerous narrow pinnæ, which are contracted at the base and of nearly uniform width throughout; margins finely serrulate; texture coriaceous. Fla. to Brazil.—Especially adapted for the edges of boggy ponds, river banks and the like. Soon forms dense clumps 2–3 ft. high.

AA. *Fertile lvs. distinct from sterile lvs., very much narrower. (Lomaria.)*

B. *Plant with an erect rigid st.*

C. *Lvs. 6–12 in. long.*

6. **Moòrei,** C. Chr. (*Lomària ciliàta,* Moore). St. 6 in. high, 1½ in. thick: stipes blackish: lvs. 8–12 in. long, the upper pinnæ with a rounded auricle at the lower side of the base; fertile lvs. narrow-linear. New Caledonia.

7. **lanceolàtum,** Sturm. St. elongate, densely clothed with dark brown scales: lvs. 6–12 in. long, 2–4 in. wide, with close, slightly falcate pinnæ; texture leathery; fertile pinnæ linear spreading. Austral. and Polynesia.

CC. *Lvs. 1½–3 ft. long.*

D. *Lower pinnæ connected at base.*

8. **díscolor,** Keys. St. ascending: stipes black, glossy, with dense scales at base: lvs. 1½–3 ft. long, 4–6 in. wide, with pinnæ narrowed suddenly toward the point; fertile pinnæ narrower and shorter. Austral. and New Zeal.

9. **gíbbum,** Mett. St. 2–3 ft. high: stipes short, with black scales: lvs. 2–3 ft. long, 6 in. wide; fertile pinnæ narrower, 4–6 in. long. Var. **platýptera** is advertised. *L. intermedia,* Hort., may be derived from this species. New Caledonia.

DD. *Lower pinnæ narrowed at base and distinct.*

10. **tabulàre,** Kuhn (*Lomària Boryàna,* Willd.). St. stout, erect, 1–2 ft. high, woody, densely scaly: lvs. 1½–2 ft. long, 6–8 in. wide, narrowed and sometimes auricled at base; fertile pinnæ narrow-linear, close. W. Indies to Patagonia, Mauritius and S. Afr.—Probably includes 2 or 3 species, among them *L. zamiæfolia,* Hort.

BB. *Plant with a stout, short, creeping rhizome.*

11. **spìcant,** With. Sterile lvs. lanceolate, 6–9 in. long, 1–1½ in. wide, gradually narrowed below; fertile lvs. 1 ft. long, with longer stalks (6–9 in.) and narrowly linear pinnæ. Eu., W. N. Amer.—The large Californian form with lvs. 2–3 ft. long is possibly a distinct species. The European plant was early called *Struthiopteris spicant* by Scopoli, by which name it is now cited as the earliest generic name. Hardy; needs deepest shade. *Lomària nippónica,* Kunze, Japan, usually larger than preceding, is much like it in other respects and probably is better to be considered as a form of *B. spicant* rather than as a distinct species.

B. orientàle, Linn., is a large E. Indian and Polynesian fern with lvs. often 3 ft. long.—Well worthy of cult.

L. M. Underwood.

BLEEDING HEART: *Dicentra.* R. C. Benedict.†

BLÉPHARIS (Greek, *eyelash;* referring to fringed bracts). *Acanthàceæ.* A large (80 species) genus of dwarf, often spiny shrubs and herbs, allied to Acanthus, and of similar culture. Fls. in bracted spikes; calyx cruciate, 4-parted nearly to the base, the 2 inner sepals much shorter than the outer; corolla short-tubed, the limb blue or white; caps. ellipsoid, flattened and woody.

carduifòlia, T. Anders. (*Acánthus carduifòlius,* Linn. *Acanthòdium carduifòlius,* Nees). Plant villous: lvs. lanceolate, sinuate-dentate, spiny: spike terminal, cylindrical: bracts roundish, palmately 5-spined at the apex. S. Afr.—Not commonly cult.

N. Taylor.†

BLEPHAROCÀLYX (*eye-lash* and *calyx,* probably referring to a fringed condition). *Myrtàceæ.* Woody plants, differing from Myrtus in having a thin crustaceous testa of the seed instead of a thick and horny one, and other minor characters, and by some authors united with that genus. There are about 30 species in S. Amer., but very little known in cult. **B. spiræoides,** Stapf (*Eugènia myriophýlla,* Hort.), is a much-branched shrub, 9 ft. high, free-flowering: lvs. lance-linear, ¾in. or less long: fls. small, pale yellow, in terminal panicles; petals 4. Brazil. B.M. 8123.

BLÈTIA (named for Louis Blet, a Spanish botanist). *Orchidàceæ.* Terrestrial orchids with globose or depressed pseudobulbs, from the apex of which arises a leafy st.; mostly hothouse plants.

Leaves plicate-veined: fls. borne on a lateral leafless st.; sepals and petals spreading, similar, or the latter broader; lip attached to the base of the column, 3-lobed, the lateral lobes erect, the middle lobe spreading, the disk with several entire or denticulate-crisped ridges; pollinia 8.—A genus of about 20 species in Trop. Amer.

A. *Middle lobe of lip much crisped.*

B. *Petals as wide as sepals: fls. rose.*

verecúnda, R. Br. Lvs. up to 3 ft. long, 2–4 in. wide: scape 2–4 ft. tall, the upper portion a raceme or panicle of numerous rose-colored fls. W. Indies and Fla. G.C. II. 26, p. 141. B.M. 3217 (as *B. acutipetala*).

BB. *Petals broader than sepals, undulate: fls. deep purple.*

Shépherdii, Hook. Lvs. up to 2 ft. long, 3–4 in. broad: scape, 2–3 ft. tall, the upper portion a raceme or panicle of numerous deep purple fls.; sepals oblong, acute, the petals broader, undulate; lip with the lamellæ white. Jamaica. B.M. 3319. P.M. 2:146.

AA. *Middle lobe of lip not crisped.*

Sherrattiàna, Batem. Lvs. up to 4 ft. long, 3–4 in. broad: fls. bright rose, in a raceme of 10 or more; sepals oblong-lanceolate, obtuse; petals much broader,

rounded at apex; middle lobe of lip not crisped, deeply emarginate. Colombia. B.M. 5646.

B. campanulàta, La Llave & Lex. Fls. bell-shaped, purple, with white center. Mex.—*B. hyacinthìna*, R. Br.=Bletilla.—*B. pátula*, Hook. Fls. up to 2 in. across, deep pink. Said to be a native of Haiti. B. M. 3518.—*B. Tánkervilleæ*, R. Br.=Phaius.

GEORGE V. NASH.

BLETÍLLA (diminutive of *Bletia*). *Orchidàceæ*. Terrestrial orchids with pseudobulbs, and a leafy st. with a terminal infl.: sepals and petals nearly alike, somewhat spreading; lip 3-lobed, furnished with lamellæ, the lateral lobes surrounding the slender column; pollinia 8.—Outdoor orchids.

hyacinthìna, Reichb. f. (*Blètia hyacinthìna*, R. Br.). Pseudobulbs tuberform: sts. up to 1 ft. tall, with 3–6 plaited lvs.: fls. racemose, on short pedicels; sepals and petals amethyst-purple; lip 3-lobed, amethyst-purple, the middle lobe nearly quadrate, denticulate. China and Japan. Gt. 15:527. Gn. 16:416. B.R. 33:60 (as *Bletia Gebina*). B.M. 1492 (as Cymbidium).—Grows beautifully in half-shady, moist places, soon forming large clumps. Prop. by division of the clumps.

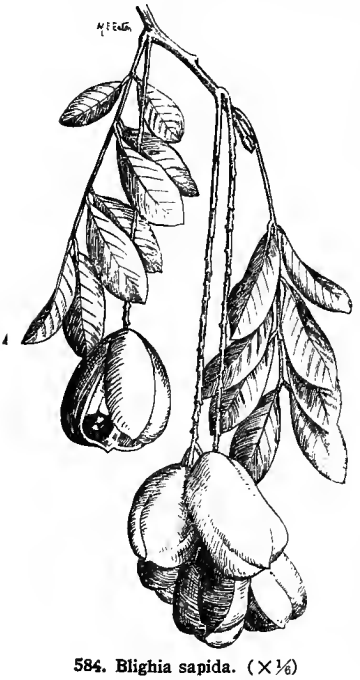
GEORGE V. NASH.

BLÌGHIA (W. Bligh, British mariner, who wrote on a journey in the South Seas, 1792). *Sapindàceæ*. Trees and shrubs with pinnately compound lvs. and axillary, racemose fls.; differs from Cupania in having a deeply cut calyx (rather than separate sepals) with the parts only slightly imbricate, and also in the fr.—One species in Guinea, now naturalized in the W. Indies, and yielding the akee, a 3-parted fr. with edible red aril that is much improved by cooking. The fls. are so fragrant as to deserve distilling. The tree reaches a height of 30 ft., and is cult. in Jamaica to an altitude of only 3,000 ft., but can endure slight frost. It is also cult. in S. Fla.

sápida, Kon. (*Cupània sápida*, Voigt.). AKEE TREE. Fig. 584. Lfts. 3 or 4 pairs, obovate-oblong, entire, veined: fls. pubescent, the oblong petals white and rather showy, bearing scales and stamens.

N. TAYLOR.†

BLIGHT. An indefinite term, popularly used to designate any sudden and inexplicable death of plants. The term is now restricted by botanists to parasitic diseases. These diseases are of two classes,—those due to bacteria or microbes, and those due to parasitic fungi. For an account of these troubles, see *Diseases*.



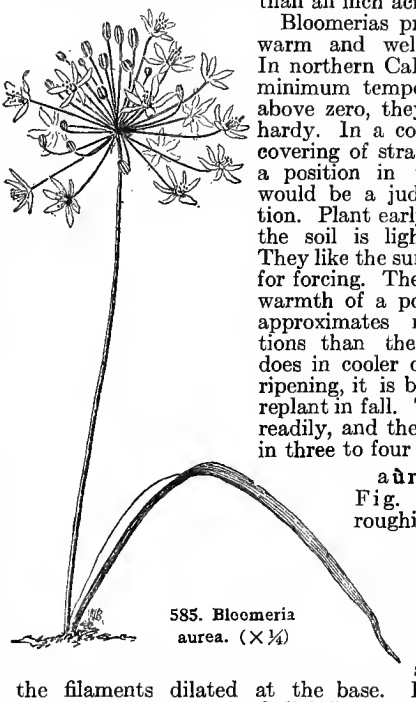
584. Blighia sapida. (×⅙)

BLITE: *Chenopodium*.

BLOODROOT: *Sanguinaria*.

BLOOMÈRIA (named for Dr. H. G. Bloomer). *Liliàceæ*. Small summer-blooming bulbous plants of the allium kind.

A genus of 2 species, natives of S. Calif. In every way they are closely allied to Brodiæa, but differ in having the perianth parted nearly to the base. Bloomerias have a flattish corm, much like Crocus, covered with fiber, and not often producing offsets. The lvs. are radical, slender, and grass-like: scape slender but stiff, 6–18 in. high, naked, except for short bracts beneath the many-rayed umbel; pedicels slender, jointed; fls. nearly rotate, less than an inch across, orange.



585. Bloomeria aurea. (×¼)

Bloomerias prefer a sandy, warm and well-drained soil. In northern California, with a minimum temperature of 15° above zero, they are perfectly hardy. In a colder climate, a covering of straw or leaves or a position in the coldframe would be a judicious precaution. Plant early, and see that the soil is light and sweet. They like the sun, and are good for forcing. The light soil and warmth of a pot more nearly approximates natural conditions than the open ground does in cooler climates. After ripening, it is best to dig and replant in fall. The seeds grow readily, and the plants flower in three to four years.

aûrea, Kellogg. Fig. 585. Scape roughish, 6–18 in.: lf. ¼-½in. broad: fls. numerous, bright orange, in a dense umbel; stamens nearly as long as the perianth, the filaments dilated at the base. B.M. 5896 (as *Nothoscordum aureum*). G.C. III. 20:687.

Clèvelandii, Wats. More slender: lvs. 3–7: fls. smaller, keeled with brown, the stamens shorter. G.C. III. 20:687.—Less valuable than the other.

CARL PURDY.

BLUEBELL: *Campanula*.

BLUEBERRY-CULTURE. Fig. 586. Blueberries are fruit-bearing shrubs of the genus Vaccinium, long gathered wild in North America in great quantities and now about to be cultivated with success.

Success in blueberry-culture rests especially on the recognition of two peculiarities in the nutrition of these plants: first, their requirement of an acid soil; second, their possession of a root-fungus that appears to have the beneficial function of supplying them with nitrogen.

If blueberries are planted in a soil with an alkaline or neutral reaction, such as the ordinary rich garden or fertile field, it is useless to expect their successful growth. In such a situation they become feeble and finally die. Blueberries require an acid soil, and they thrive best in that particular type of acid soil which consists of a mixture of pure sand and peat. The peat may be of either the bog or the upland sort.

Good aëration of the soil is another essential. It is commonly but erroneously supposed that the swamp blueberry (*Vaccinium corymbosum*), the species chiefly desirable for cultivation, grows best in a permanently wet soil. It is to be observed, however, that the wild plants of the swamps occupy situations which though perhaps submerged in winter and spring are exposed during the root-forming period of summer and autumn, or, when growing in permanently submerged places, they build up a hummock or a cushion of moss which rises above the summer water-level and within which the feeding-roots of the bush are closely interlaced. In actual culture, moreover, it has been found that the swamp blueberry does not thrive in a permanently wet or soggy soil.

Although some species of Vaccinium, such as the common low-bush blueberry, *V. pennsylvanicum*, grow and fruit abundantly in sandy uplands that are subject to drought, the swamp blueberry grows best in soils naturally or artificially supplied with adequate moisture.

These then are the three fundamental requirements of successful blueberry culture: (1) An acid soil, especially one composed of peat and sand; (2) good drainage and thorough aëration of the surface soil; and (3) permanent but moderate soil-moisture. Under such conditions, the beneficial root-fungus which is believed to be essential to the nutrition of the plant need give the cultivator no concern, for it will propagate itself spontaneously and adequately, without any necessity of soil or plant inoculation.

Propagation.

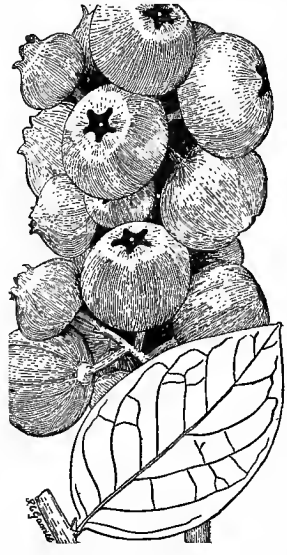
Blueberry plantations may be formed by the transplanting of unselected wild bushes or by the growing of seedlings, but such a course is not the best. Seedling plants, even from the largest-berried parents, produce small berries oftener than large ones. Until nurserymen are prepared to furnish plants asexually propagated from superior stocks, the cultivator should begin by the transplanting of the best wild bushes, selected when in fruit for the size, color, flavor, and earliness of the berry, and the vigor and productiveness of the bush. These he should propagate by layering and by cuttings until his plantation is completed. By means of a combination of these two methods, a valuable old plant can be multiplied by several hundred at one propagation, the fruit of the progeny retaining all the characteristics of the parent.

Large berries cost less to pick than small ones and bring a higher price. A berry ⅘ of an inch in diameter has already been produced under cultivation and others of still larger size are to be expected.

While grafting and especially budding are useful in experimental work, neither method is suitable for commercial plantations because blueberry bushes are continually sending up new and undesirable shoots from the stock. The best season for budding is from the middle of July to the end of August. The budded plants should be protected from direct sunlight, and special care should be taken that the raffia wrapping does not become wet for the first three weeks.

The easiest way to propagate the swamp blueberry is by a special process of layering known as "stumping." In early spring, preferably before the buds have begun to push, all the stems of the plant, or as many as it is desired to sacrifice for propagation, are cut off close to the surface of the ground. The stumps are then covered to the depth of 2 inches with a mixture of about four parts of clean sand and one of sifted peat. The sand-bed must not be allowed to become dry, except at the very surface. The new growth from the stumps, which without the sand would consist of stems merely, is transformed in working its way through the sand into scaly, erect or nearly erect rootstocks which on reaching the surface continue their development into leafy shoots. Although roots are formed only sparingly on the covered bases of stems, they develop quickly and abundantly on these artificially produced rootstocks. By the end of autumn the shoots are well rooted at the base. They should remain in place in the sand-bed through the winter, exposed to freezing temperatures. Early in the following spring, before the buds have begun to push, each rooted shoot is carefully severed from the stump. The upper portion of the shoot is discarded, the cut being made at such a point as to leave on the basal portion about three buds above the former level of the sand-bed. The rooted shoots are potted in clean 3-inch porous pots in a soil consisting of two parts of rotted upland peat to one of sand and one of clean broken crocks. They are then plunged in sand in a shaded coldframe or greenhouse, with abundant light but no direct sunlight. For the first two months the temperature should be kept below 65° F. When subjected to high temperatures, the newly cut shoots are liable to die and rot from the base upward. Watering should be infrequent, only sufficient to keep the soil moist but well aërated. The frame should receive ventilation but not enough to cause the new twigs to droop. They are very susceptible to over-ventilation and overheating just before they complete their primary growth. After the new twigs have stopped growing and their wood becomes hard, new root-growth takes place. Then secondary twig-growth follows. Not until this has occurred is the life of the plant assured. Those plants that make sufficient growth to require repotting during the first summer should be transferred to clean pots of 2 inches larger diameter in a standard blueberry soil mixture.

A very successful potting mixture, or nursery-bed mixture, for blueberry plants consists of one part of clean or washed sand, nine parts of rotted upland peat, either chopped or rubbed through a sieve, and three parts of clean broken crocks. No loam and especially no lime should be used. Manure is not necessary, and in the present state of our knowledge may be regarded as dangerous, although in small amounts it serves to stimulate the plants, at least temporarily. The danger from manure apparently lies in its tendency to produce an alkaline condition in the soil.



586. Swamp Blueberry. A cluster of berries on a budded greenhouse plant. (×½).

The use of crocks in the potting mixture is based on the fact that the rootlets seek them and form around them the same mats that they form at the wall of the pot, thus increasing the effective root-surface and the vigor of growth.

The peat most successfully used for potting blueberry plants is an upland peat procured in kalmia, or laurel, thickets. In a sandy soil in which the leaves of these bushes and of the oak trees with which they usually grow have accumulated and rotted for many years untouched by fire, a mass of rich leaf-peat is formed, interlaced by the superficial rootlets of the oak and laurel into tough mats or turfs, commonly 2 to 4 inches in thickness. These turfs, ripped from the soil and rotted from two to six months in a moist but well aërated stack, make an ideal blueberry peat. A good substitute is found in similar turfs formed in sandy oak woods having an underbrush of other ericaceous plants than laurel. Oak leaves raked, stacked, and rotted for about eighteen months without lime or manure are also good. The leaves of some trees, such as maples, rot so rapidly that within a year they may have passed from the acid condition necessary for the formation of good peat to the alkaline stage of decomposition, which is fatal to blueberry plants. Even oak leaves rotted for several years become alkaline if they are protected from the addition of new leaves bearing fresh charges of acidity.

By ordinary methods, cuttings of the swamp blueberry have been rooted only in occasional instances. Two successful methods, however, have been especially devised for these plants. The most novel of these but the one

easiest of operation is that of "tubering." This method involves the same principle as that employed in stumping, namely the forcing of new shoots in such a manner that their basal portions are morphologically scaly rootstocks, with a strong rooting tendency. This method of propagation from stem cuttings is called tubering because the treatment as well as the behavior of the cuttings is essentially identical with that which takes place in reproduction from tubers, as in the case of the potato.

The cuttings are made in late winter or early spring, and the whole plant may be used, including old stems an inch or more in diameter. With a saw and knife cut the wood in pieces about 4 inches long. Lay these horizontally in a shallow, well-drained box containing a bed of clean sand and cover them with half an inch of the same material. Water the sand well, cover the box with glass, and keep it at a temperature of 60° to 65°, or less if the equipment does not permit the maintenance of such a temperature. The sand-bed must be kept moist, although if there are only slight apertures beneath the glass, a second watering may not be required for several weeks.

At the temperature already specified, shoots should begin to appear above the sand within six weeks. The boxes should then be placed in good light but protected from direct sunlight, and, when warm weather approaches, they should be given the coolest situation available so as to keep the temperature below 65° as long as practicable. When the first shoots have stopped growing and their foliage has turned to a mature green color, they are ready to produce roots. A half-inch layer of finely sifted rotted peat should then be added to the surface of the sand-bed and thoroughly wet down with a fine spray. The box should remain in this condition, with a little ventilation but a saturated or nearly saturated atmosphere, until new shoots cease to appear. Meanwhile, during the spring and early summer the older shoots will have formed roots between the surface of the ground and the point at which they sprang from the cutting. After a shoot is well rooted it will make secondary twig-growth, and if the development of roots has not already been ascertained by direct examination, the making of such secondary growth is good evidence that rooting has actually taken place. If the rooted shoots have not already disconnected themselves from the dead cuttings they should be carefully severed with a sharp knife. They are then potted in 2-inch pots in the standard blueberry soil mixture already described, and during a period of three or four weeks they should be gradually changed from their saturated atmosphere and full shade to open air and half sunlight. If preferred, the shoots may remain in the original cutting-bed until the following spring, before potting, the cutting-bed being exposed to freezing temperatures during the winter.

When blueberry plants, either large or small, are grown in porous pots, the surface of the pot should never be allowed to become dry, for the rootlets, which grow through the soil to the wall of the pot for air, are exceedingly fine and easily killed by drying, to the great injury of the plant. This danger may be eliminated by plunging the pots to the rim in a well-drained bed of sand, or by setting the pot in another pot of 2 to 4 inches greater diameter, with a packing of moist sphagnum between, and crocks at the bottom.

A burning of the young leaves and growing tips of twigs is often produced by the hot sun from the middle of June to the middle of September. Plants in pots or nursery beds are easily protected from such injury and forced to their maximum growth by a half-shade covering of slats, the slats and the spaces between being of the same width. On cloudy days the shade should be removed. It should not be used in fall or spring.

During the winter the rooted cuttings or one-year-old plants should be kept outdoors, exposed to freezing temperatures, their soil mulched with leaves, preferably oak leaves. When kept in a warm greenhouse during the winter they make no growth before spring. Even then their growth is abnormal, often feeble, or sometimes deferred for a whole year.

Plants from cuttings or rooted shoots are ready for permanent field planting when they are two or three years old and about 1½ to 2 feet high. They are best set out in early spring before the buds have begun to push.

The field plantation.

It is a curious fact that these plants send out no new roots in spring until they are in full leaf, their flowering is nearly or quite finished, and their principal twig-growth has ceased. It is important, therefore, in taking up either a wild or a cultivated plant from the open ground, that as much as possible of the old root-mat be lifted with the plant, for upon this they depend for moisture until their new rootlets are formed.

In the case of mature wild bushes with very large root-systems, when it is practicable to secure but a fraction of the root-mat, say a disk only 3 or 4 feet in diameter, it is the best procedure to cut all the stems to the ground at the time of transplanting. The bush will then produce a new and symmetrical top of a size suited to the capacity of the roots. The wood that is removed may be used for cuttings if the plant is sufficiently valuable.

A plant pollinated with its own pollen, or with pollen from its asexual offspring, produces fewer, smaller, and later berries than a cross-pollinated plant. In a field of plants propagated from cuttings or layers, two parent stocks should be used, a row of plants from one stock being followed by a row from the other.

In the permanent field plantation the bushes should be set 8 feet apart each way. When they reach mature size they will nearly or quite cover the intervening spaces.

To secure full vigor of growth, the ground between the bushes must be kept free from all other vegetation. On rocky uplands a continuous mulch of oak leaves, when it is practicable to secure them, will help toward this end as well as keep the soil in the necessary acid condition. It is more economical, however, to choose such a location for the plantation as will permit the use of horse-drawn machinery, and will make mulching unnecessary.

The most favorable location for blueberry-culture is a boggy area with a peat covering and sand subsoil, the peat preferably of such a thickness that a deep plowing will turn up some of the underlying sand.

The land should be so ditched that the water-level can be kept at least a foot below the surface of the ground during the growing season or can be raised for subirrigation during a drought.

The ground should be plowed to the depth of about 8 inches and repeatedly harrowed during the season preceding the planting, in order to kill the vegetation. After the plants are old enough to have formed a root-mat, the harrowing should be very shallow, not more than 2 or 3 inches, so that the roots will not be injured.

By proper manipulation in the greenhouse, seedling blueberry plants can often be made to ripen a few berries in less than a year, but they do not come into commercial bearing in field plantations until they are about five years old, when the plants are 3 to 4 feet high. They then increase slowly to full size and full bearing.

The field plantings resulting from the recent experiments in blueberry culture are too young to show the mature yield. Fortunately, however, there has been found, near Elkhart, Indiana, a small blueberry plant-

ing of mature age, believed to be the only commercial plantation in existence, which sets forward our knowledge of yields by at least a decade. The plantation is a little less than two and a half acres in extent. It was started in 1889 in a natural blueberry bog, which was first drained and then set with unselected wild blueberry bushes. Exact records of yield and receipts are available only for the years 1910 to 1912. They are as follows:

Year	Yield Qts.	Price (approx. avg. per qt.)	Receipts
1910 (a year of "almost total failure" because of late spring freezes)	1040	17⅛ cts.	$178 25
1911	5620	12⅞ cts.	725 25
1912	5900	12⅞ cts.	758 25

The annual expenses for weeding, cultivation, and irrigation were about $50. The cost of picking was 5 cents a quart. The general cost of maintenance of the equipment was about $5 per year, the crates and boxes being used repeatedly.

Estimating an annual charge of $30 for interest, $5 for taxes, and $10 for depreciation, the profits for these three years are computed as follows:

Year	Profits per acre
1910	$10
1911	139
1912	147

It must be borne in mind that these figures are based on the yields from wild bushes transplanted without selection as to individual productiveness or the size of the berries. With bushes propagated from selected stocks, the yield should be greater and the berries much larger, this greater size probably effecting a reduction in the cost of picking and certainly an increase in the selling price.

FREDERICK V. COVILLE.

BLUE FLAG: *Iris.*

BLUETS: *Houstonia.*

BLUMENBÁCHIA (after Dr. J. F. Blumenbach, professor at Göttingen, 1752–1840). *Loasàceæ.* S. American plants allied to Loasa and Mentzelia (prairie lilies), not cult. in Amer. because of their covering of stinging hairs. The fls. are odd and pretty, axillary, solitary and bracteate: lvs. opposite, lobed. The garden forms are mostly treated as tender annuals. Prop. by seeds, to be sown in pots in spring. Transplant only when danger from frost is over.

B. chuguitênsis, Hook. f. Lvs. 8–10 in. long: fls. 1½–2 in. long, brick-red, tipped yellow without, and yellow within; petals 5–10, boat-shaped. Peru, Ecuador. F.S. 22:2358. B.M. 6143.—*B. coronàta*, Haage & Schmidt. 1½ ft.: lvs. narrow, bi-pinnatifid: fls. half hidden by the lvs., 2 in. diam., pure white. R.H. 1874, p. 58. F.M. 1874. 139.—*B. grandiflòra*, Don (B. contorta, Hook. f. B.M. 6134). Lvs. 4–6 in. long: fls. 1½–2 in. long, wholly red; scales ¼in. long, cup-shaped, green; stamens in 5 bundles, with long filaments. Peru. *B. insignis*, Schrad. St. climbing, 4-sided: petals white, unguiculate. B.M. 2865.—*B. laterìtia*, Brit. (Cajophora lateritia, Benth.) Lvs. pinnate, with roundish lobed lfts: fl.-stalks, twin, single-fld.: fls. orange-red. S. Amer. B.M. 3632. B.R. 24.22.

N. TAYLOR.†

BOCCÒNIA (after Dr. Paolo Bocconi, Sicilian botanist and author). *Papaverâceæ.* PLUME POPPY. TREE CELANDINE. Tall garden herbs, suitable to the hardy border.

Herbs, but sometimes almost shrubby, glaucous: lvs. lobed: fls. small, many, in terminal panicles; sepals 2, colored; petals wanting; stamens many: fr. a stalked caps., few-seeded.—Four or 5 species in American tropics, and China and Japan. The well-known China-Japanese species, *B. cordata*, is by some recent authors referred to Macleya, *B. frutescens* and *B. integrifolia* (latter apparently not cult.) representing Bocconia as limited.

The large, handsome leaves remind one, by their texture and lobing, of bloodroot and Stylophorum, which belong to allied genera. The flowers are very unlike our common poppies, being small and without petals, but they are borne in great feathery or plumy masses, in terminal panicles raised high above the heavy foliage, making the plant unique in its picturesque general appearance. Hence, it is much used for isolated lawn specimens, or for very bold and striking effects, being especially adapted to be viewed at long distances. It is also placed in shrubberies, wild gardens, and at the back of wide borders. It spreads rapidly by suckers, any of which, if detached, will make a strong plant in a single season. The plume poppy seems to be much hardier in America than in the Old World. It was popular early in the century, but was neglected,

587. Bocconia cordata.

probably because it spread so rapidly. Lately it has become popular again. It deserves to be permanently naturalized in the American landscape. To produce the largest specimens, it is well to plant in very rich soil, give the old clumps liquid manure in spring, and cut off the suckers. Propagation chiefly by suckers. See Pflanzenreich, hft. 40, p. 217 for the latest monograph.

cordâta, Willd. (*B. japónica*, Hort.). Fig. 587. Hardy herbaceous perennial: height 5–8 ft.: lvs. large, glaucous, heart-shaped, much lobed, deeply veined: fls. pinkish; stamens about 30. China, Japan. B.M. 1905. Gn. 54, p. 279. Gng. 5:342.

microcárpa, Maxim. Perennial, 9 ft.: fls. golden brown or bronzy, in immense panicles, summer: lvs. much as in *B. cordata*. N. China. R.H. 1898, p. 362, f. 125.

frutéscens, Linn. Perennial, somewhat shrubby, 4–9 ft.: lvs. pinnatifid, pale green, often glaucescent beneath, ovate-oblong, cuneate at the base, 6–12 in. long: fls. greenish, the panicle often a foot long. Oct. Mex. and Peru. L.B.C.: 83.—Intro. by Franceschi in 1895.

B. integrifòlia, Humb. & Bonpl. 9 ft.: fls. greenish: lvs. nearly entire. Peru. Is sometimes cult.—*B. macrocárpa*, *B. Giràlda* and *B. Thùnbergii* are trade names, the first two referable to B. cordata, the last probably to B. microcarpa.

N. TAYLOR.†

BOÈA (name obscure, probably personal). Sometimes spelled *Boœa*. *Gesneriàceæ*. Allied to Streptocarpus, sometimes found in choice collections. Differs from Streptocarpus in having a short corolla-tube and a broadly campanulate fl., no disk, and very minor characters. Boeas are perennial herbs with ovate or oblique lvs. radical or opposite on a very short st.: peduncles axillary or elongated leafless scapes, the fls. small or medium in size, blue.—Species 16–20 in E. Asia and to Austral. and Seychelles. **B. Clarkeàna,** Hemsl., from China, has been offered in the trade: lvs. radical, roundish, strongly crenate, petioled, bronze-green above and maroon-red beneath: fls. 3–4 on each peduncle, clear azure-blue with a whitish spot.

BOEHMÈRIA (G. R. Boehmer, a German botanist). *Urticàceæ*. A fiber plant; and a greenhouse shrub or tree.

Leaves alternate or opposite, often 3-nerved: fls. monœcious or dicecious, in dense clusters; petals none; sepals 2–5: fr. a flattened achene. *B. nivea*, Gaud., of Trop. Asia, is cult. in some countries as a fiber plant, and has been intro. into this country for that purpose. Now grown extensively in Calif. and La. for its fiber. See Report No. 2, office of Fiber Investigations, U. S. Dept. Agric., and Cyclo. Amer. Agric. II, p. 284. It produces ramie. It is a strong-growing, large-lvd. perennial, well suited to the border as an ornamental subject. A genus of 45 widely distributed species of shrubs, trees or herbs.

argéntea, Lind. Fig. 588. Tree, 10–30 ft.: lvs. alternate, ovate, long-acuminate, 8–10 in. long, 3–5 in. wide, usually silvery: fls. in an axillary compound catkin-like cluster, 6–10 in. long. Mex.—An excellent warmhouse plant, cult. mostly in botanic gardens, but worthy of wide attention.

B. macrophýlla, Don. A shrub or small tree: lvs. lanceolate, 6–9 in. long, serrate, prominently 3-nerved: spikes slender, usually shorter than the lvs. Himalayan region. N. TAYLOR.

BOG-GARDENING. The growing of plants in swamps, marsh-spots and bogs: distinguished from water-gardening or aquatic-gardening in the fact that the plants are not immersed or floating but grow mostly free above the soil. When water-gardening is made to include bog-gardening, confusion in practice is likely to result because the cultural requirements are unlike.

Bog-gardens may be separate areas in themselves, or they may comprise the edges of water-gardens or the spongy ground along runnels or the margins of pools. Bog-gardening is mostly a practice in colonizing plants, finding the ones that are specially adapted to the particular place. The artistic scheme is one of informality. If the place is very soft, stepping-stones may comprise the walks. Hereabouts may be grown the many marsh and wet-land plants, many of which are showy and also little known to cultivators. The sparganiums, pontederias, some of the hibiscus (page 338), many orchids, loosestrifes, cephalanthus, utricularias, and a host of others will occur to frequenters of morasses and distant shores. L. H. B.

BOLÁNDRA (H. N. Bolander, Californian botanist). *Saxifragàceæ*. Two species of small W. American herbs offered for borders and wild gardens.

Flowers purplish in lax corymbs; petals 5, inserted on the throat of the 5-lobed calyx; stamens 5, alternate with petals. Delicate herbs, suitable for rockwork where there is a plentiful supply of moisture.

oregàna, Wats. A foot or 2 high, pubescent and glandular: lvs. laciniately toothed and lobed: fls. deep purple; tube of the calyx equaling the teeth and a little shorter than the petals: pedicels reflexed in front. Ore. and Wash.—Intro. by Gillett in 1881.

The first-described species, *B. califórnica*, Gray, seems not to have been offered in the trade. It is a smaller species, less pubescent with smaller fls., the lower lvs. round-reniform and 5-lobed: plant 3–12 in. high, the sts. weak and slender.

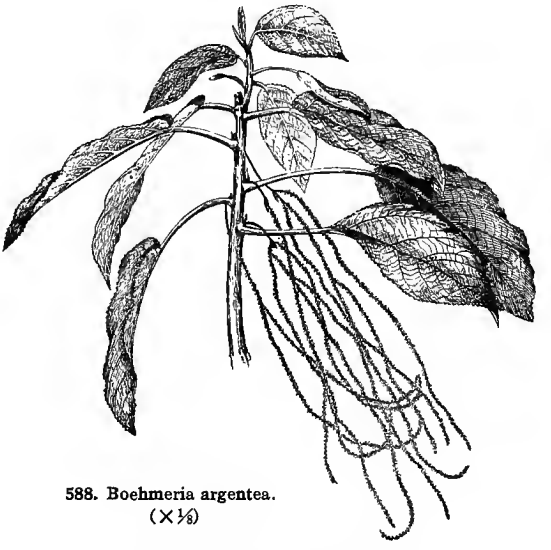
BOLDÒA FRÀGRANS, cult. in S. Calif.: *Peumus.*

BOLÈTUS: *Mushroom.*

BÓLLEA (in honor of Dr. Karl Bolle). *Orchidàceæ*. Epiphytic greenhouse orchids without pseudobulbs, with flat lvs., and lateral 1-fld. peduncles: sepals and petals nearly alike, spreading, the lateral sepals forming a distinct chin; lip articulated to the column-foot, entire, the margin revolute, furnished with a thick ridged plate, over which the stout column extends; pollinia 4. —A Trop. American genus of 4 species.

A. *Recurved tip of lip purple.*

violàceum, Reichb. f. (*Húntleya violàcea*, Lindl. *Zygopétalum violàceum*, Reichb. f.). Fls. deep violet; sepals and petals broad, undulate; lip ovate, cordate, the tip recurved. British Guiana. F.S. 7:678. P.M. 8:1.



588. Boehmeria argentea. (×⅙)

AA. *Recurved tip of lip yellow.*

B. *Fls. violet or purple.*

cœléstis, Reichb. f. (*Zygopétalum cœléste*, Reichb. f.). Lvs. up to 1 ft. long and 2 in. broad: fls. 3–4 in. across; sepals and petals bluish violet, with yellow tips, the dorsal broadly obovate; petals similar to the dorsal sepal; lip colored like the petals, the crest buff. Colombia. B.M. 6458. Gt. 31:1075. Lind. 2:61. G. 16:99. Gn. 31, p. 121.

BB. *Fls. rose-colored.*

C. *Sepals and petals light rose.*

Pátinii, Reichb. f. (*Zygopétalum Pátinii*, Reichb. f.). Lvs. up to 1 ft. long and 2–3 in. wide: fls. 3–4 in. across; sepals and petals light rose, undulate, the lower side of the lateral sepals darker; lip triangular-hastate, yellow. F.M. 1875:147. G.C. II. 3:9.

CC. *Sepals and petals dull rose, tipped with yellow and margined white or yellow.*

Lalíndei, Reichb. f. (*Zygopétalum Lalíndei*, Reichb. f.). Lvs. as in *B. Patinii*, but fls. smaller and darker; lip ovate-hastate, yellow. Colombia. B.M. 6331. O.R. 8:369. GEORGE V. NASH.

BÓLLEO-CHONDRORHÝNCHA. A cross of *Bollea cœlestis* with probably *Chondrorhyncha Chestertonii*, with both of which it was found growing in Colombia, whence it was intro. to the collection of Otto Froebel of

Zurich in 1898. It has received the name **B.-C. Froebeliàna,** Cogn. This natural hybrid has a slender erect peduncle 4 in. long, at the top bearing 2 membranous bracts half the length of the ovary: fl. 3¼ in. wide, the sepals and petals lanceolate-ligulate, yellow-white, lightly tinged with rose, especially at the summit; dorsal sepal pointed, curving outward at the top, the lateral ones much incurved; petals obtuse, almost flat, curved back at the tip; lip somewhat thick and fleshy, more delicate than in *B. cœlestis,* the blade widely obovate and rounded; crest orange-yellow, with a yellowish border and an edge of brown-purple.

589. Boltonia latisquama. (×½)

BOLOCANTHUS, BOLUSANTHUS: *Lophocarpus.*

BOLTÒNIA (James Bolton, English botanist). *Compósitæ.* False Chamomile. Four or 5 species of aster-like glabrous often glaucous herbs of the United States and eastern Asia, sometimes planted in borders and wild gardens.

They are tall and leafy plants, blooming profusely in late summer and autumn, and excellent for the hardy border. They have alternate, entire and sessile or clasping lvs. and angled, often striate, sts. Differs from Aster in having very few pappus bristles which in Aster are numerous, and in other technical characters.

Boltonias are of easiest culture. They take care of themselves when once established. Propagation is effected by division. Should be better known to gardeners. They stand without staking.

asteroìdes, L'Her. (*B. glastifòlia,* L'Her.). Sts. 2–8 ft., simple below and branching at the top: lvs. broadly lanceolate or the upper narrower: heads short-peduncled, numerous, the rays varying from white to violet and purple; involucral bracts lanceolate and acute, greenish; scales of the pappus numerous and conspicuous, the 2 awns sometimes missing. Pa. to Ill. and S. B.M. 2381, 2554. Mn. 1:33. Gn. 74, p. 438. R.H. 1903, p. 59.—Perennial.

latisquàma, Gray. Fig. 589. A handsomer plant, with larger and more showy heads with blue-violet rays: involucral bracts oblong or obovate and obtuse (often bearing a minute point); pappus scales small, the awns present and conspicuous. Kan. and Mo. to Ark. G.F. 5:271 (adapted in Fig. 589). C.L.A. 7:490. Perennial. Var. **nàna,** Hort. A dwarf form scarcely 2–3 ft. tall, with pinkish rayed fls. Branches freely from the base.

B. cantoniénsis, Franch. & Sav., is native to Japan, where the young plants are used for greens. See Georgeson, A.G. 13, p. 8, fig. 4. It is annual. Has not yet appeared in the American trade. Gray restricts Boltonia to the U. S., and regards his species as of another genus. *B. lævigàta,* Hort.=*B. asteroìdes*(?).

L. H. B.
N. Taylor.†

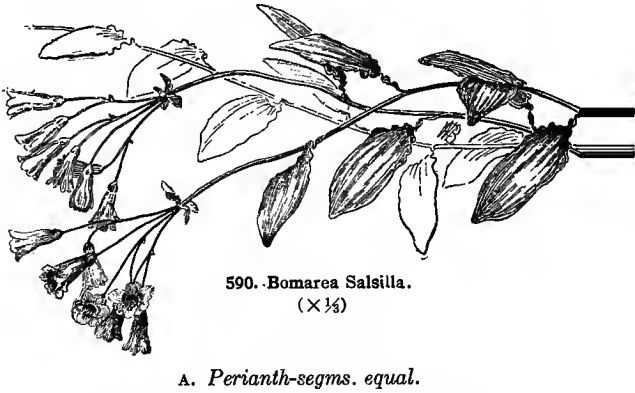
BOLUSANTHUS: *Lonchocarpus.*

BOMÀREA (named after the French botanist, J. C. W. de Bomare). *Amaryllidàceæ.* Tender South American plants allied to Alstrœmeria, and with similar fls. but a twining habit. Lvs. parallel-veined, usually borne on short, twisted petioles: fls. in pendulous umbels, variously colored and spotted, borne in early spring and summer; perianth funnel-shaped; tube none.

The most beautiful species now grown is probably *B. Carderi.* It has large terminal cymes of rose-colored flowers, about 2 inches long, with dark purple spots and blotches. Another valuable form is *B. Shuttleworthii* with pale yellow flowers, spotted with green.

Bomareas delight in a rich, fibrous soil, and require plenty of water during the growing season, which begins early in the spring. A little well-decayed cow-manure mixed with the soil improves the growth and results in larger clusters of flowers, as does also manure watering during the growing season. Late in fall the stems are cut down to the ground and the roots are kept in the soil in a dry state. While they often make satisfactory pot-plants, they do best when planted out in an open sunny position in a cool conservatory where they have plenty of air in summer. In the south, bomareas may be grown in the open air on trellises in half-shady places. All are woodland plants and cannot be successfully grown in the glaring heat of the sun.

Propagation is by fresh seeds, which germinate readily if sown in shallow pans in a warm propagating-house; also, and more rapidly, by careful division of the rhizome, to which some of the roots should be attached.



590. Bomarea Salsilla. (×⅓)

A. *Perianth-segms. equal.*
B. *Umbel simple; fls. medium-sized.*

oligántha, Baker. Lvs. 3–4 in. long, oblong, acute, lax, thin, densely pubescent beneath: fls. 6–8 in an umbel; bracts large, lf.-like; segms. 1–1¼ in. long, outer dull red, inner bright yellow with reddish brown spots. Peruvian Andes.

BB. *Umbel compound.*

C *Fls. small.*

Salsílla, Herb. (*B. oculàta,* M. J. Roem. *Alstrœmèria oculàta,* Lodd.). Fig. 590. Lvs. 2–4 in. long, ½in. broad, lanceolate or oblong-lanceolate, moderately firm, glabrous beneath: umbel 4–15-rayed; rays 1–3 in. long, 1-3-fld.; bracts small; fls. pink or red, marked with blue and dark purple within. Chile. L.B.C. 19: 1851. B.M. 3344.

591. **Bombax malabaricum.** (×⅛)

CC. *Fls. large.*

Cárderi, Mast. Lvs. 4–6 in. long, 1½–3 in. broad, oblong, acute: umbel 1 ft. long, 6–9-rayed; rays 1–4-fld.; bracts large, leafy; perianth-segms. 2 in. long, outer pale pink, spotted brown near the top, inner greenish white, much spotted. F. M. 1876: 239. G.C. II. 5:793.

chontalénsis, Seem. Lvs. 6–8 in. long, broadly lanceolate: umbel very large; rays 4–6-fld.; fls. numerous, 2½ in. long; outer segms. waxy, wavy margined, rosy red or pink with brown spots, inner ones thinner, pale greenish yellow, spottcd.—The largest-fld. species; very effective when well grown.

Shúttleworthii, Mast. Lvs. 5–6 in. long, oblong, acute, glabrous: umbel 1 ft. long, 5–10-rayed; rays usually 3-fld.; perianth-segms. 2 in. long, outer reddish, inner greenish yellow. Colombian Andes. G.C. II. 17:77, 85.—The curious egg-shaped tubers terminate unbranched roots, which spring from a rhizome about 1 in. wide. Having no eyes or buds, they cannot be used for propagating.

AA. *Perianth-segms. not equal, the inner longer.*

B. *Umbel simple.*

patacocénsis, Herb. (*B. conférta,* Benth.). Sts. purple-tinted, pubescent: lvs. 5–6 in. long, oblong-lanceolate, pubescent beneath: fls. 20–30; outer segms. 1½ in. long, bright red; inner ones 2½ in. long, bright red, yellow-keeled, with a few spots. Andes of Ecuador and Colombia. G.C. II. 17:187. B.M. 6692.—When well grown, the umbel is very dense and many-fld.

Caldasiàna, Herb. Lvs. thin, spreading, oblong, acute, distinctly petioled, 3–6 in. long, glaucous, puberulent beneath: umbel 6–30-fld.; bracts many, oblong-lanceolate; pedicels 1–2 in. long, pilose; outer segms. reddish brown, about 1 in. long, inner ½in. longer, bright yellow. B.M. 5442 (as *Alstrœmeria Caldasii*).

BB. *Umbel compound.*

vitellìna, Mast. Lvs. 3–4 in. long, ovate-oblong: umbel about 12-rayed; perianth-segms. bright yellow, outer 1½ in. long, inner 2 in. long; bracts large, leafy. Peruvian Andes. G.C. II. 17:151.

B. Wércklei, Lemoioe. Lvs. lanceolate, acuminate, bright green: fls. about 12 in a terminal umbel, vermilion—orange with orange-yellow inside. Costa Rica. N. J. Rose.†

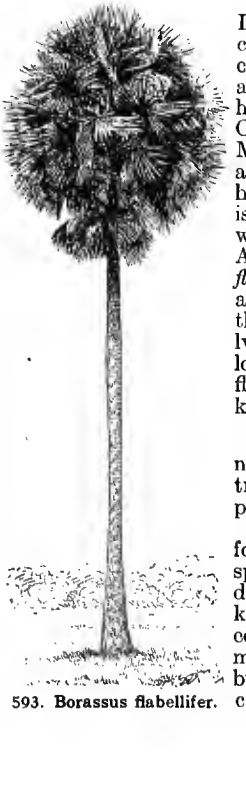
BÓMBAX (a Greek name for *raw silk,* alluding to the cottony contents of the pods). *Bombacàceæ.* Silk Cotton Tree. A genus of 50 species of tropical shrubs and trees, with digitate 5–9-foliolate lvs., 1-fld. axillary or clustered peduncles, and usually large white or scarlet fls. Specimens are rarely seen in cult. in fine glasshouses, and only 1 of the species appears to be in the American trade. The bark of some species produces commercial fiber such as the Kapok fiber.

malabàricum, DC. (*B. Ceìba,* Burme.). Fig. 591. Large deciduous tree, the branches in whorls, the trunk and branches spiny: lvs. 5–7-foliolate, palmate, the lfts. entire, cuspidate: fls. 6–7 in. long, clustered near the ends of the branches, red or scarlet, sometimes white: fr. a 5-valved caps., silky. India.—A very showy plant, excellent for warmhouse, but tender. Intro. in U. S. by Royal Palm Nurseries in 1912. N. Taylor.

592. **Borage—Borago officinalis.** (×⅛)

BONESET: *Eupatorium perfoliatum.*

BOOKS: *Literature.*



593. **Borassus flabellifer.**

BORAGE (*Boràgo officinàlis,* Linn.). Fig. 592. *Boraginàceæ.* A coarse annual plant grown for culinary use in some parts of Eu., as in Germany. Used as a pot-herb and sometimes with salads. Only the young lvs. are palatable. Mostly known in this country as a bee-plant and for its handsome blue or purplish racemed fls. It is a hairy plant, 1½–2 ft. high, with oval or oblong lvs. Eu., N. Afr. Eng. Bot. 1:36. *Boràgo laxiflòra* DC., is a small, decumbent alpine, but of easy cult., offered in the trade. It has alternate, ovate lvs., hairy throughout, and pretty, long-peduncled, purple or violet fls. Corsica. B.M. 1798.—Little known in Amer. N. Taylor.†

BORÁSSUS (an old name, of no significance here). *Palmàceæ,* tribe *Borássineæ.* Tall unarmed palms, with ringed trunks.

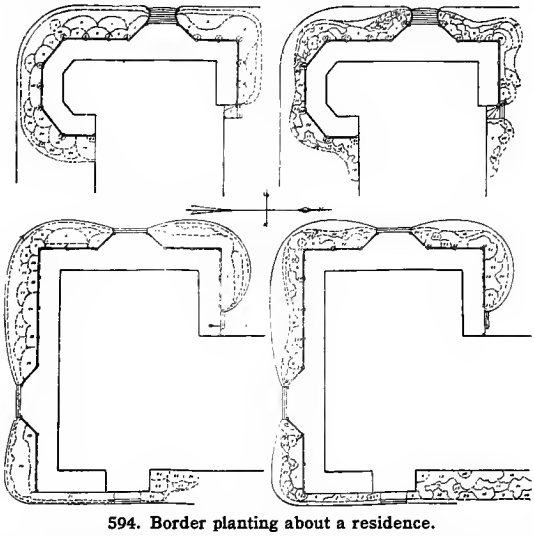
Leaves large, palmately flabelliform; plicate sheath short; petiole spiny; ligule short rigid: fls. small, densely packed in pits on the catkin-like branches of a spathe which comes out between the lvs.; stamens 6.: fr. large, subglobose, brown.—Species 1. Trop. Afr. For cult., see *Latania.* The seeds are

very hard and do not germinate readily unless given strong bottom heat and abundant moisture.

flabellífer, Linn. (*B. flabellifórmis,* Murr. *B. æthiòpium,* Mart.). MEELALLA, a native name for young plants; called also PALMYRA PALM by the Hindoos. Fig. 593. St. 60–70 ft. high: lvs. 8–10 ft. long, broader than long; lf-segms. bifid at the apex, lanceolate or sword-shaped in outline.—Widely cult. One of the most useful palms of India. The frs. are very large. Many parts of the plant are utilized by the natives as food and in the arts. Wood black, very hard. This plant requires rich soil and strong heat for its best development, and is rather slow-growing under cult., especially while young.

N. TAYLOR.†

BORDER. In gardening practice, the term "border" is employed to designate definite strip-planting on the margins. The margin may be along the boundary of a yard, park or other area; close about a residence or other building; or a parallel of walks and drives. In all these positions, the border becomes a part of the artistic landscape plan. In some cases borders are designed separately as flower-garden or ornamental features, as margins or boundaries of an avenue of sod



594. Border planting about a residence.

or of a formal walk. The border derives its value from its relationship as well as from its intrinsic character. It is a conception of boundaries and inclosures, and consequently is part in a design of open centers and good lawns. It develops mass effects rather than the detached and spot effects of lawn beds and of single planting; and it derives much of its pleasing result from its length, distance and perspective. The border may be permanent, comprised of hardy plants; or it may be a bedding form of gardening, using temporary subjects; or it may have a framework of hardy material, with inter-planting of bulbs and annuals and greenhouse plants. Borders are often designed to carry and emphasize one idea,—the idea of larkspurs or of hollyhocks, for example; and in such cases the dominance is secured by similarity, and repetition of one plant-form. These borders, when well made, are most effective; but they do not cover the entire season unless expensive efforts are made to replant with other things as soon as the desired effects are passed. Figs. 594–596 show the placing of borders in recognized landscape plans; and Fig. 597 suggests how a mixed hardy border works itself out. Fig. 598 shows the emphasis of a single strong plant-form set against a border rather than to be placed alone in the lawn without background or support.

L. H. B.

The hardy border.

The hardy border has assumed a new relation to ornamental planting within recent years in America. Once only occasional, it now forms a dominant part of many gardens previously given up almost entirely to the display of greenhouse plants or tender annuals. Properly designed for a specific purpose, it is capable of giving a maximum of pleasure for a minimum of effort and expense. Now that plants, especially American native plants, are coming to be valued for their intrinsic beauty and interest rather than for their rarity and cost, the hardy border is a more personal and individual expression than some other forms of garden effort.

The informal hardy border is often the most charming, and nature has provided us with many roadside or meadow-corner examples of exquisite beauty. Such a border may change not only with the day but almost from morning until afternoon during the luxuriant June weeks. It may follow the chromatic balance of the season from the brightness of spring hues through the cooler tones of summer until the rich tints of the autumn asters and goldenrods blend into the warmer colors of the aftermath that remains to enhance the effectiveness of the winter's snow in making the border a continuous pleasure. This informal planting can be handled with individuality and changed to suit knowledge, circumstance and surroundings without destroying its charm. The wild things that are picked up—let us hope without ever exterminating a plant colony anywhere—in a day's woodland ramble, belong in this informal border. Often the border is built around or with reference to some essential tree or larger shrub, as a rugged old pine, or a picturesque clump of lilac, or a mass of rhododendrons. It may combine shrubby, herbaceous and bulbous plants to advantage.

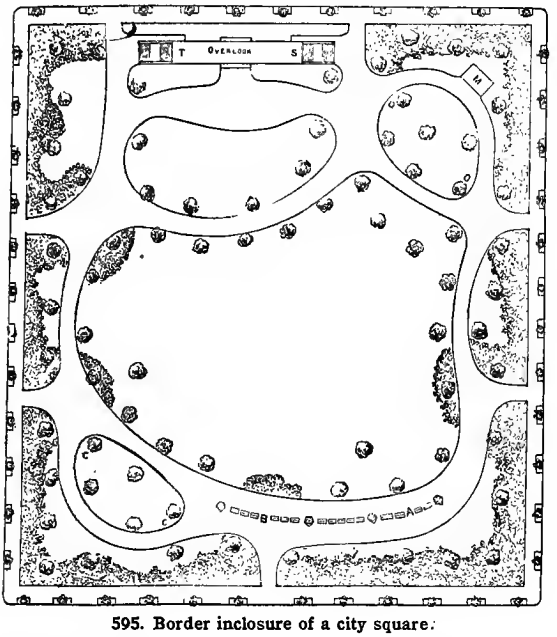
The formal hardy border has been exemplified in some notable New England gardens. It is usually formed with masses of similar plants—as a long strip of delphiniums, a great body of aquilegias, serried rows of phloxes, or lupines,—and at times is effectively combined with architectural adjuncts in the so-called "Italian" style, or with evergreen trees of formal or clipped outline. But the "barbered" formal border is passing, and even in the best American example of a formal hardy garden, made up of various borders, the edging of the daintily informal evergreen pachysandra gives a note of variation that is significant and pleasing. The hollyhocks, foxgloves and similar treasures of all gardens are indispensable in the formal border to carry line and give contour and mass. In one notable example, the background of a succession of fine hardy borders is a clambering mass of Crimson Rambler roses hanging over a great wall.

In the conventional hardy border, the shrubby plants are used less freely than the herbaceous perennials, and the bulbs still less freely, as yet. The shrubs, if selected properly as to character, eventual height, color, time of bloom and effect of foliage, may well form a framework in which to set the higher colors of the composition supplied by the herbaceous plants—the peonies, iris, gaillardias, veronicas, and the like. Or it is practicable to build the border entirely without shrubs, depending only on the masses and forms available in the plants that die to the ground each winter. With the increase in variety of herbaceous plants now commercially available everywhere, a very delightful and continuous succession of bloom may be had.

The bulbous plants—of course as fully herbaceous as any, but distinguished in trade parlance by their "onions" instead of roots, and their different dormant conditions—should come to more importance in the hardy border. They give colors, forms, fragrance and effects unique to the class. The popular conception of "bulbs" has centered around tulips and hyacinths, the so-called "Dutch" bulbs, but the various narcissi, the

XVI. Botanic garden.—The formal garden of Johns Hopkins University

scillas, snowdrops, anemones, and especially the lilies, are more adapted to the permanent border than these. The narcissus, for instance, in several largely grown forms, adapts itself to both the informal and formal border plantings. Combined with iris and lilies, and using certain of the late-flowering tulips, effects as permanent as they are pleasing are now produced, and at little expense. The fancier of rare things may indulge



595. Border inclosure of a city square.

himself according to his resources with the newer and more unusual forms; there are narcissi in commerce at $60 each and $5 is cheerfully paid for a gladiolus bulb.

While the nature of hardy garden flowers, with the relief of varied green foliage, seems to make agreeable a heterogeneous color-combination, yet more pleasing pictures are painted in harmonizing or properly contrasting hues. The raw scarlet of the oriental poppy or the kniphofia, for example, does not "go" or compose agreeably with pink or magenta phlox. It is well to keep tiger lilies and certain pink hibiscus colors from fighting each other, as another example. Indeed, a fascination of the hardy border is this opportunity to select and combine hues that shall match and succeed each other agreeably. A border is in mind that blended insensibly from deep crimson at one end through white to pink and white to yellow along to orange and scarlet at the other end. There was no clash. It must be said, however, that if the larger and more vividly colored flowers are judiciously placed, the general mixture of blooming plants in a border is wholly agreeable, even as an oriental rug including many hues in small masses is agreeable.

Fragrance, also, is a quality to plan for in hardy borders,—here a bit of bergamot in a half-shady corner; there the stateliness and the sweetness of many lilies. The funkia scents the evening air, and the wild rose is as fragrant in foliage as in flower. There is added delight in the odorous quality of certain shrubs.

An interesting feature of the border is the seasonal succession of its bloom. It may begin before spring is more than an atmospheric hint, with its hepaticas, certain violets, and the snowdrops and crocuses. After that there need be no flowerless moment until a freeze—not a mere frost—stops the glow of the chrysanthemum and finishes the dainty display of the monkshood. The garden may also continue to please through extended weeks by changing foliage and by bared twigs of bright colors, as well as by glowing fruits that hang, like the barberries, until the next spring signals retirement.

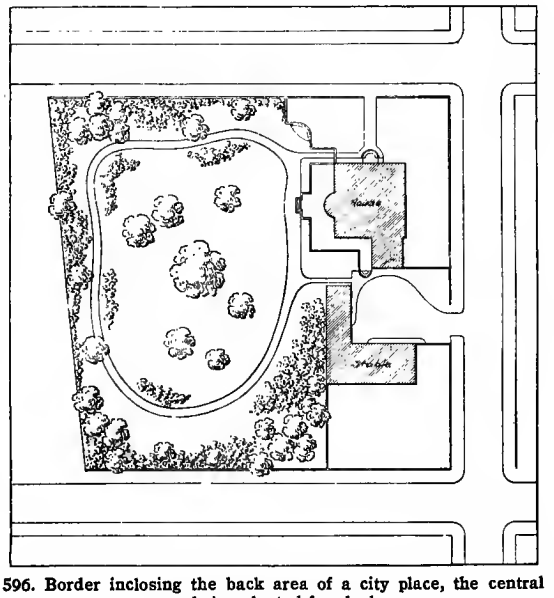
A pleasing way of creating hardy borders is by the segregation of genera and families. Iris will cover four months with varied flowers of as varied heights. All the columbines may cover many weeks in time of beauty. A collection of viburnums makes a shrub border of long showiness. Lilies are gorgeous, or dainty; they are short or stately, and they include months of bloom-time as a family. There is great delight in studying plant families grouped in neighborly fashion.

The hardy border may endure full sun or deep shade, with all variations between, if its citizens are selected for their adaptability. Some plants of the border need wet feet; others are best, like the moss pink, on a dry and sterile sunny bank. It is this great range that makes the good border so very good, for it reflects the adaptability of nature for thousands of years.

The plants for a border are now legion. The nurserymen in these days have considered the needs of the planter, and there is little difficulty in securing what is wanted. Certain tradesmen grow perennials in small pots, available nearly all the growing season. But a personal hardy border can be made with little aid from the nurseryman. The man—or woman—who loves them can transplant hardy plants with success at any time of the year when the ground is not frozen deeply, and such persons find plants in the wild that may be separated without destroying colonies of a kind. There is also the fascinating and inexpensive method of growing the perennials from seed, resulting in more knowledge gained through failures; and in enough successes to furnish plenty of plants to the grower and his friends. The hardy border of the personal sort is a great educator in patience, perseverance and knowledge of plant life. J. Horace McFarland.

The making of the border.

Perennial herbaceous plants should form the major part of the planting in most borders, as these are permanent and eliminate the necessity of replanting the whole each year. Biennials, such as the Canterbury bells and foxglove,—for these are best treated as such,—



596. Border inclosing the back area of a city place, the central area being planted for shade.

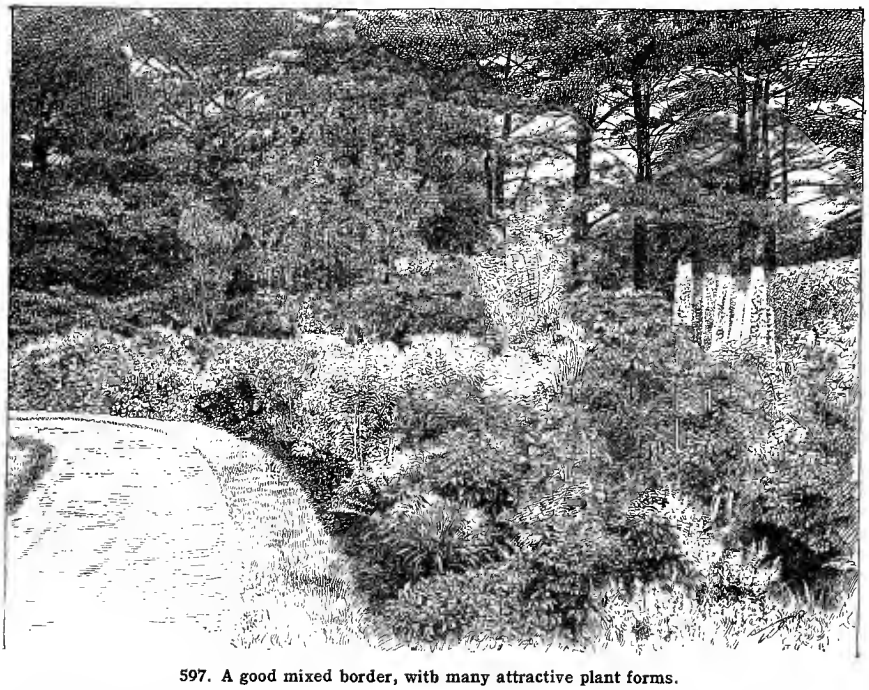
hollyhocks and sweet williams are an essential that should be provided for in a reserve garden, and moved to the place in which they are desired to bloom as gaps occur. Annuals are necessary, such as mignonette, larkspur, candytuft, asters, stocks and other favorites to help out the display during July and August, for this is a period when perennials in bloom are scarce. There should be a background of shrubs with a group or individual dwarf shrub here and there to break up the flatness, especially in winter and early spring.

It is a question whether spring-flowering bulbs are admissible in this type of permanent border. It is better to keep them in a place by themselves for the reason that it is difficult to make changes when the ground is planted with bulbs, and to lift these at stated periods necessitates disturbing all the other occupants. A group of Darwin tulips here and there is much admired and in keeping, but a general planting is better made elsewhere, as under trees and among ferns.

A border being permanent, no effort should be spared to prepare thoroughly in the beginning. Deep-rooting plants, as peonies, hemerocallis, delphiniums and columbines, require deep preparation of the soil and liberal enrichment, double-digging or trenching being essential. It is better, if possible, to prepare and plant a portion at a time rather than to plant in a hurry and go over it all again later. If the soil is heavy, add sand and coal-ashes, so that it may be easier to work at all times. If the soil is inclined to be wet, it must be drained to take care of surplus water. A dry soil can be improved by the addition of leaf-mold, and provision must be made for watering in dry seasons. It is not necessary to lay the pipes deep if there is a natural pitch to the land, the water then being turned off late in the year and the pipes drained for safety. Faucets should be so placed that 50 feet of hose will water any part that needs it; thus the outlets may be 100 feet apart.

The grouping of plants in a mixed border is governed by the width and extent of this border. In large, wide spaces, ample groups of each plant are necessary to secure the desired effect and to avoid "spottiness." Large-growing permanent plants, as peonies, boltonias, heleniums, rudbeckias and even silphiums and late-flowering asters should be planted at the back; in front of these, the phlox in separate colors, or at most two colors together that will harmonize, German iris in masses of one or more colors, bleeding heart, campanulas, *Veronica subsessilis*, monarda, oriental poppy, columbines, pyrethrums, perennial candytuft, and, in front of these, the usual dwarf edging plants, as arabis, alyssum, the Carpathian harebell, shooting-star, erysimum, *Tunica saxifraga*, geum, *Heuchera sanguinea* and others. If the border is narrow, individual treatment must be followed to secure a greater variety, and it is always permissible to add the old favorite sweet-smelling plants and herbs, such as balm, thyme, lemon verbena, southernwood, rosemary, rue, marjoram, borage and fennel, and some sweet geranium. All these give interest when flowers are waning, and call up associations helping to take the memory back to old friendships.

A border of this kind will need the addition of annuals to take the place of the earlier flowering plants that are past. Seeds of mignonette may be sown in the place where they are to flower; snapdragons may be raised in frames or hotbeds and set out among other plants that are passing; the scarlet salvia may be put where its color will not clash when in flower; gladiolus may be set out in groups of one color; *Hyacinthus candicans* looks well in fall when planted at the back; in fact, the mixed border of today should contain every desirable plant that has either sentiment or blossoms — possibly both — to recommend it.

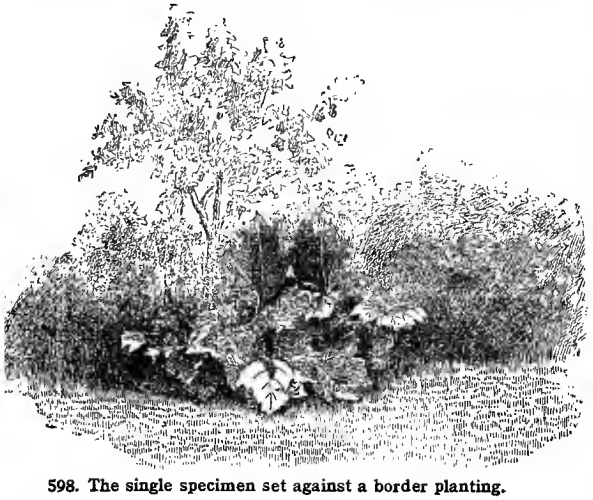


597. A good mixed border, with many attractive plant forms.

Lilies often do well in partially shaded situations in which moisture is sure and leaf-mold has been added. They should never be treated to manure. They are best seen when planted in masses sufficient to make a display in their season. *L. auratum* never lives long but is good for a year or two; *L. speciosum* is a better lily to keep; the tiger lily always remains with us as do also *L. umbellatum*, *L. Hansonii*, *L. Thunbergianum* or *L. elegans;* and great results are expected from the new Chinese *L. myriophyllum* and others of recent introduction. The flower-stalks of lilies should never be pulled up in fall, but cut off at the ground. It is a protection to the heart of the bulb to let the stem remain.

Perhaps the most important detail of the management of the border is that of protection in winter. The border should be protected and nourished at the same time; this is possible when a quantity of well-decayed manure and leaf-mold is available for a top-dressing, preferably after a little frost has penetrated the soil. This can be lightly forked into the soil in spring, but a spade should never be used except when making

changes. The great charm of this form of gardening is, after all, the necessity of change from year to year. It must not in any sense be considered changeless. Some plants will outgrow their allotted space and must be restricted, biennials will die out and need replanting, some color scheme may be wrong and need alteration, other really good things will need to be divided and replanted, and in this way the interest is kept up by the taking of notes through the season for reference at



598. The single specimen set against a border planting.

the planting-time; and this is best done after the fall rains in September and early October before the soil loses its warmth, root-action being rapid then, and the roots soon become established before winter. There is always enough to do in spring, and changes in the borders left for that time are often made at the sacrifice of the display due in summer-time. Much misconception was the result of the term "perennial border." The plants were not all permanent, and the display was not continuous. Out of it has been evolved a much more satisfactory thing in that it calls for endless study, a greater variety containing all the good things, and the possibility of change each season as fancy dictates.

In wide borders especially, it adds greatly to the effect to plant some dwarf-growing shrubs near the path, such as Lemoine's deutzia and philadelphus, some specimens of the new choice lilacs (double and single), *Daphne Cneorum*, the dwarf flowering crabs like *Malus Toringo* and *M. Ringo*. These are all very beautiful and stand close inspection. The shrubs may be so arranged as to form bays for groups of plants, either for certain seasons or color effects, and if there is a tendency to outgrow the situation, pruning judiciously will help if done directly after the flowering season is past, with no sacrifice of bloom, always taking care to keep the individual shape of each shrub. Shears must never be used on shrubs, but shorten-in the longer shoots with a knife.

The Japanese iris, if used in the border, must be planted near water so they can be frequently irrigated in dry times or failure is sure to ensue. They are semi-aquatic and will take much nourishment also. The German kinds require a warm sandy soil, and a dry time in late summer suits them well. They are also best transplanted in September before the heavy rains, as root-action begins at this time and they become reëstablished before the winter sets in.

Borders need constant care in summer to keep them trim and clean. All seed-stems and dead flowers should be removed, tall-growing plants staked up with neat stakes, and, above all, plants grown in reserve to take the place of such as are dying out after blooming. There is no more interesting phase of gardening than this, because it calls for care and study all the time, year by year, and our failures of this season are with us to profit by during the next. E. O. Orpet.

BORECOLE: *Kale.*

BORÉTTA: *Dabœcia.*

BORÒNIA (after Francis Borone, an Italian who lost his life at Athens in the service of Dr. Sibthorp). *Rutàceæ*. Greenhouse shrubs, interesting, and very fragrant.

Boronia is a genus of Australian shrubs with numerous fls., having a rue-like fragrance: lvs. opposite, odd-pinnate, or simple: fls. axillary and terminal, red, rarely white or purplish, on the plan of 4, bearing a thick entire disk: fr. 2–4 carpels, each 1- or 2-seeded. *B. megastigma* and its allies, *B. elatior* and *B. heterophylla*, are remarkable for their very large stigma (which is 4-lobed at the base), and their curious stamens, 4 of which are small, yellow, pollen-bearing, and hidden under the stigma, while the 4 large, conspicuous ones are dark purple or black, and bear no pollen.—About 60 species, in Australia.

The chief value of boronias is their delicious fragrance. A small specimen will perfume a whole house for two or three weeks. Boronias are cultivated like Cape heaths in a cool greenhouse. After flowering they should be cut back, in order to make compact, bushy specimens. The leading shoots may be frequently pinched, to prevent a straggling growth. As most of them are native of barren sandy places, not bogs, good drainage is necessary. "Sour" soil is very disastrous to them. The English florists set their young plants in the open ground during summer, being careful to shade them with lath frames. Plants that have flowered two seasons are thrown away and replaced by younger specimens. They are propagated by cuttings from half-ripened wood inserted in 4-inch pots, which are filled to within an inch of the top with a compost of finely sifted loam, peat and sand, over which is spread a layer of sharp sand. After a thorough watering, they may be placed under a bell-glass in a greenhouse in which the temperature ranges from 45° to 50° F., and shaded from bright sunshine. Seeds germinate readily in the same temperature, and make good flowering plants in one season. Seeds can be obtained from German or Australian dealers, large quantities being collected in the wild. Boronias belong to a large class of hard-wooded Australian plants that were popular along with the Cape heaths in the early part of the nineteenth century. These were largely replaced by quicker-growing, soft-wooded plants. The renewed interest in boronias is largely due to the more recently introduced species, of which the first three described below are the best. American florists have lately grown them somewhat for Easter, especially *B. heterophylla*. Many species are likely to be introduced, as these shrubs are very brilliant in Australia, blooming when very young, and remaining attractive for two or three months.

599. Boronia megastigma. (×½)

A. *Stigmas large.*

B. *Lvs. less than 1 in. long; lfts. in 1 or 2 pairs, plus an odd one.*

C. *Fls. borne singly.*

megastígma, Nees. Fig. 599. Height about 2 ft.: lvs. very sparse, ⅛–⅜in. long, sessile, the upper with 1 pair, the lower with 2 pairs of lfts. beside the end one; lfts. narrowly linear: fls. maroon-purple outside, yellow within, borne less densely than in *B. elatior*. At times some fls. are chiefly brown, others chiefly purple. B.M. 6046.—Var. **aùrea,** Hort., has pale creamy yellow fls.

CC. *Fls. borne in whorls of 4 or 6.*

heterophýlla, F. Muell. Height 5–6 ft. in Austra.: lvs. 1–1½ in. long, sometimes simple, usually with 1 pair, rarely 2 pairs, of lfts.: fls. bright scarlet, but usually pictured as purplish crimson. Differs from *B. elatior* and *B. megastigma* in its larger lvs, fewer lfts., more brilliant fls. and longer filaments. Cult. only in its var. **brévipes,** Hook. f., which differs merely in the shorter peduncles. B.M. 6845. Gn 32:442.—Of late years it has been grown for Easter by florists to a considerable extent.

BB. *Lvs. more than 1 in. long; lfts. in 2–6 pairs, plus an odd one.*

elàtior, Bartl. Height about 4 ft.: pubescence variable: lvs. close-set, 1–2 in. long, ½–¾in. broad, petioled, with lfts. in 2–6 pairs; lfts. broader and shorter-acuminate than in *B. megastigma*: fls. dark red-brown, or rosy red, or purple, sometimes showing groups of widely different colors on the same branch, and borne so densely as to hide one side of the branch. B.M. 6285. Gn. 10:312. F.E. 9:491.

AA. *Stigmas small.*

pinnàta, Smith. Lfts. in 2–4 pairs, very smooth, acute: peduncles dichotomous, 5–7-fld.; stamens 8. B.M. 1763. L.B.C. 5:473.

tetrándra, Labill. Lfts. in 4–5 pairs, obtuse, glabrous; branches pilose: pedicles short, 1-fld.: stamens 4.

B. denticulàta, Smith. 2–6 ft.: lvs. mucronate, denticulate: fls. in peduncled corymbs, rose-purple.—*B. Fràseri,* Hook. (B. anemonifolia, Paxt.). 1–3 ft.: lvs. trifid, the wedge-shaped segms. entire or 2–3-toothed: fls. axillary, solitary, pink. New Holland. P.M. 9:123.—*B. pulchélla,* Turcz. (B. Drummondii, Planch.). 2 ft.: lvs. pinnatifid: fls. rose-pink, freely produced in spring and summer. Var. *álba.* A white-fld. form is known. F. S. 9:881.

WILHELM MILLER.
N. TAYLOR.†

BORZICÁCTUS: *Cereus.*

BÒSEA (after Kaspar Bose, German amateur of plants, at Leipzig, about 1700). *Amarantàceæ.* Syn., *Bosia.* Woody plants, rarely cultivated for their ornamental crimson berries.

Upright shrub: lvs. petioled, alternate, ovate to ovate-lanceolate, entire: fls. small, with 2–4 bracts at the base, in terminal spikes or racemes; sepals and stamens 5; petals wanting; ovary with 3 subulate stigmas: fr a 1-seeded berry.—Three species in the Canary Isls., Cyprus and Himalayas. They can be cult. only in warmer temperate regions. Prop. by seeds and probably by cuttings of young wood.

Amherstiàna, Hook. (*Rodètia Amherstiàna,* Moq.). Glabrous shrub: lvs. ovate, acute or acuminate, 3–6 in. long, narrowed at the base into a petiole ¼–½in. long: fls. perfect, greenish, ⅙in. across, sessile, with 2–4 bracts at the base, in terminal panicles: berries globose, ⅙in. across, crimson. W. Himalayas.—Adv. as *Bohea Amherstiana.* The closely related *B. yervamòra,* Linn., from the Canary Isls., is sometimes cult. in Old World botanic gardens; it differs chiefly in its short-stalked, polygamous fls., with only 2 bracts at the base.

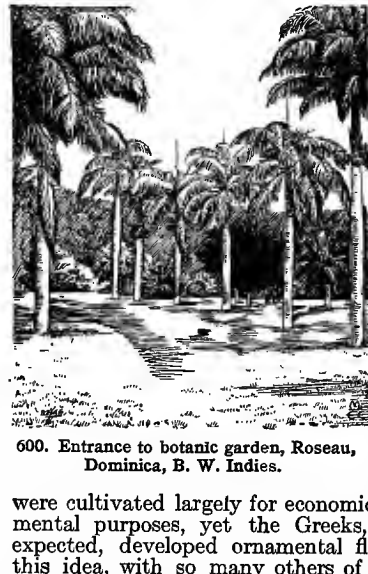
ALFRED REHDER.

BOSTON FERN: *Nephrolepis.*

BOTANIC GARDEN. A collection of growing plants, the primary purpose of which is the advancement and diffusion of botanical knowledge.

This purpose may be accomplished in a number of different ways, and by placing emphasis on different departments of the science. Some gardens, for example, are preëminently centers of systematic botany, or taxonomy; others of plant physiology and morphology; while in two or three cases, more than special emphasis is placed on botanical education, or formal instruction, as distinguished from, or in close connection with, research. But whatever the method, or wherever the emphasis, the aim is the advancement of botany as distinguished from horticulture or agriculture. Some of the ideas embodied in botanic gardens are displayed in Figs. 600–603.

All the scientific and educational work of a botanic garden centers around the one important and essential problem of maintaining a collection of living plants, both native and exotic. The extent to which this may be done depends largely on the local climate, and extremes are found in such gardens as Christiana, Norway, where the glasshouse is of prime importance, and Havana, Cuba, or Buitenzorg, Java, where the tropical climate renders a conservatory superfluous. At Buitenzorg there are coolhouses instead of hothouses.



600. Entrance to botanic garden, Roseau, Dominica, B. W. Indies.

Many ancient gardens were little more than olive orchards, and one of the earliest of these of which there is any authentic record is the temple garden of Karnak. There was recently discovered at Thebes the tomb of Nekht, the head gardener of this place, who is believed to have designed it during the reign of Thotmes III, about 1500 B. C.

While the early gardens were cultivated largely for economic rather than ornamental purposes, yet the Greeks, as may well be expected, developed ornamental flower-gardens, and this idea, with so many others of Greek origin, was borrowed by the Romans. Among the best known of the Roman ornamental gardens were those of Lucullus, and of Pliny the younger.

We learn from Pliny that during the first century of the Christian era, Antonius Castor maintained in Rome a garden of medicinal plants. Four hundred years previous to this however, or about 350 B. C., a botanic garden was established in Athens by Aristotle. The first director of this garden was Theophrastus, a pupil of Aristotle, who fell heir to it on the death of the latter, and was able to improve it by means of funds supplied by a philanthropic citizen of Athens.

The gap between these more ancient gardens and those of today is, however, a wide one, and the modern botanic garden may be considered as more immediately derived from the private gardens of the herbalists in the sixteenth and seventeenth centuries. One of the best known of these was the garden of John Gerarde, in Holborn. The plants here grown were chiefly medicinal herbs, and the study of these collections, together with the attempts to describe the plants accurately, gradually developed into modern systematic botany.

The organization of all modern botanic gardens is very similar in broad outline. There is usually a director, with a scientific staff, and a head gardener, with assistants. Some gardens are purely scientific institutions. Such were the early gardens of Michaux, in Charleston, South Carolina, of Darlington, in Chester, Pennsylvania, of Bartram, in Philadelphia, and of Hosack, in New York City, all long since extinct, and the Cambridge (England) Physic Garden. A large number of "botanical stations" and "acclimatization gardens" in the various colonies of European countries, the Desert Botanical Laboratory of the Carnegie Institution of Washington, at Tucson, Arizona, and the Acclimatization Garden of the same Institution at Carmel, California, all devoted entirely to scientific research, are often classed as botanic gardens, although not such in a strict sense of the term.

Many of the more purely scientific gardens are connected with universities, or other institutions of learning, or closely affiliated with them. This, for example, is true of the Hortus Botanicus at Amsterdam, where

601. View in a botanic garden, showing related plants in groups.

were conducted the epoch-making experiments of De Vries with the evening primrose, *Œnothera Lamarckiana*, and other species, culminating in the elaboration of the mutation theory, giving a new stimulus to studies in experimental evolution and plant-breeding, and incidentally illustrating how studies in pure botanical science, made primarily for their own sake, and seeming, at first thought, ever so academic or impractical, may be of inestimable value to such applied sciences as horticulture and agriculture.

Among other botanic gardens forming an integral part of the organization of collegiate or university departments of botany may be mentioned those of Aberdeen, Dundee and St. Andrews universities in Scotland; those of Birmingham, Cambridge and Oxford universities, and of the Royal Agricultural College at Cirencester (Gloucester), in England; that of Trinity College (Dublin), in Ireland; those of the universities at Budapest, Czernowitz, Krakau, Lemberg, Prag, and Vienna, in Austria-Hungary; of Ghent and Liege, in Belgium; of Copenhagen, in Denmark; of the Catholic university, in Lille; and the medical college and the veterinary college in Lyons, France; those of the universities of Bonn, Breslau, Göttingen, Halle, Munich, Strassburg, and Würzburg, in Germany; of Athens, in Greece; of Groningen, Leiden, and Utrecht, in Holland; of Genoa and Modena, in Italy; of Kiev, Odessa, and St. Petersburg, in Russia; of Basel, in Switzerland; of Nikko and Tokyo, Japan; and in the United States, those of the University of California (Berkeley), Harvard University (Cambridge, Massachusetts), Smith College (Northampton, Massachusetts), Mt. Holyoke College (South Hadley, Massachusetts), Michigan Agricultural College (Lansing), the University of Michigan (Ann Arbor), the University of Minnesota (Minneapolis), the University of Pennsylvania (Philadelphia), and Johns Hopkins University (Baltimore).

It is not uncommon in European countries to find botanic gardens in connection with gymnasia (high schools), and normal schools, but the only instance of this kind in the United States, known to the writer, is the botanic garden of the Michigan State Normal School, at Ypsilanti. This garden, with an area of 3 acres, serves only the purpose of supplying study-material for the courses in botany, nature-study and agriculture.

It will be seen at a glance that botanic gardens are much more common in Europe than in the United States, and especially under governmental auspices. The National Botanic Garden, at Washington, D. C., has not been developed as a scientific institution to the extent of several private or semi-private foundations.

Other so-called botanic gardens are little more than public pleasure parks. Golden Gate Park, the municipal park of San Francisco, and primarily a pleasure park, is administered with some regard to scientific ideas, and is sometimes referred to as a botanical garden. Here, also, for example, may be classed Prospect Park, in Brooklyn, in which the labeling of the trees gives a somewhat botanical aspect to the place. This park is said to contain more different species of trees, both native and foreign, than can be found elsewhere in America outside of a true botanic garden or arboretum.

A third type of garden combines the features of a scientific institution for research and education with those of a public park. Of this nature are the Kew

Gardens, near London, the Jardin des Plantes, Paris, the Berlin Botanic Garden, at Dahlem, the New York Botanical Garden, in Bronx Park, the Missouri Botanical Garden, St. Louis, the Botanic Garden of the Imperial University, at Tokyo, Japan, and the new Brooklyn Botanic Garden.

It has already been implied above that the early study of botany was closely connected with the use of plants for medicine, gardens being largely, or even exclusively, devoted to growing medicinal herbs. In this connection it is interesting to note that while the staple food, fodder, and fiber plants are grown as crops, pharmacists and physicians have, with few exceptions, such as the opium-poppy and the ginseng, always depended upon wild plants. This practice of gathering only wild herbs doubtless accounts in large part for the well-known and, until recent date, quite general adulteration of drugs.

The total number of botanic gardens outside the United States is approximately 325. In our own country there are about sixteen, eleven of which are college and university gardens. The following foreign gardens are referred to in the order of their establishment.

Foreign gardens.

1. Pisa, Italy, founded in 1543, by order of the Grand Duke Cosmo de Medici I. The second director of this garden was Cæsalpino, after whom the leguminous genus Cæsalpinia, was named. This was one of the earliest gardens devoted to the public study of botany.

2. Muséum d'Histroire Naturelle, Paris, founded in 1635 by Guy de la Brosse, physician to the king. Its first name was Jardin Royal des Plantes Medicinales, which was changed to the present name in 1790. The gardens proper occupy 14 hectares out of a total of 23.

3. Chelsea Physic Garden, London. Established by the Society of Apothecaries, in 1673, for the stated purpose of furthering the teaching of botany, and of providing material and opportunity for botanical research. The educational and scientific influence of this garden can hardly be overestimated. It was founded by the Society of Apothecaries of London, in 1606, and originally comprised the Grocers' Company, an ancient guild. In 1617 a new charter was granted by James I, and the Society of Apothecaries became separate from the Grocers' Company. From the start the Society was active in advancing botanical knowledge, and soon after its incorporation, field trips, called "herbarizings," were held at irregular intervals, and to these irregular trips a regular annual one was added about 1633. The botanical interests and activities of the Society found natural expression in 1673 in the establishment of the Physic Garden. At first the ground was utilized not only for growing specimens for scientific study, but also for growing crops of medicinal plants sufficient to furnish crude drugs for the commercial use of the Society. However, when Sir Hans Sloan, in 1722, deeded to the Society additional ground, adjacent to the original 4 acres of the garden, in the terms of the deed was a prohibition of this practice, and the garden became from thenceforth devoted to investigation and instruction.

The garden entered upon a new epoch with the appointment, as "gardener," of Philip Miller, well known as the author of the classic "Dictionary of Gardening." The title of "gardener" was subsequently changed to "curator." In 1681 steps were taken toward the development of a botanical library, which, by 1769, contained about 300 bound and unbound books, dealing chiefly with botany. In 1835 John Lindley was appointed Director of the Garden.

It was in connection with the Society's endeavor to grow successfully plants that could be grown only with difficulty or not at all in the smoky atmosphere of London that the well-known "Wardian case" was devised, by Nathaniel Bagshaw Ward, Fellow of the Royal Society, and a friend and patron of the Physic Garden. These "closely-glazed cases" were first described by Ward in a letter to Sir William Hooker, dated 1834, and published in the "Companion to the Botanical Magazine," in May, 1836. It was also found possible, by employing these cases, to ship living plants across the tropics from the southern to the northern hemisphere with the loss of scarcely a plant, whereas, under former methods of shipment many more plants perished than survived.

Among many important publications growing out of the work of the Chelsea Physic Garden or produced by members of its staff, may be mentioned Curtis's "Linnæus's System of Botany," and his "Botanical Magazine," and "Flora Londonensis;" Lindley's "Flora Medica," and Lindley and Moore's "Treasury of Botany;" Miller's "Gardeners' Dictionary," mentioned above; and Hudson's "Flora Anglica." In 1902 a well-appointed laboratory building was opened in the garden. In this building are two small rooms which contain the private library of Charles Darwin. The library equipment is used by students of the Royal College of Science, and the Professor of Botany of the college is Scientific Advisor to the Committee of Management. The garden is used freely and largely by teachers with classes, and living material for class study is supplied in quantity to the University of London, the Royal College of Science, and other local schools.

4. Royal Botanic Gardens, Kew, London (1759). The present gardens resulted from the fusion of two royal estates, the Richmond Gardens and the original Kew Gardens. Richmond Gardens, composing the western portion of modern Kew, were the grounds of the royal residence of Edward I. The second half was the private grounds of Kew House. Lord Capel, who, by marriage, came into possession of Kew House in 1696, was greatly interested in the cultivation of plants, and his collections formed the nucleus of the modern Kew plantations. The property was leased to Frederick, Prince of Wales, about 1730, and after his death, his widow, Princess Augusta of Saxe Gotha engaged, in 1759, William Aiton, a former pupil at the Chelsea garden, to establish a physic garden: its rank as a true botanic garden may be considered to date from this year. The union of Richmond and Kew was effected in 1802.

Under Aiton was inaugurated the plan of sending out expeditions for botanical exploration in foreign countries, a practice which has greatly enriched the herbarium and living collections, and which has been carried out on a large scale and with similar results in America by the New York Botanical Garden. Perrédès states that the specimen on which L'Héritier founded the genus Eucalyptus was collected on one of these expeditions to the Cape in 1772. In 1789 Aiton published his now classic "Hortus Kewensis." He was succeeded in the directorship by his son William T. Aiton, and the latter, in 1841, by Sir William J. Hooker, although Aiton retained directorship of the pleasure-grounds until 1845.

Hooker's aims were to make Kew so attractive as to create in the general public an interest in plants, to advance pure and applied botany, and to train collectors and gardeners. The area of the garden has increased from 15 acres, when Sir William Hooker became director, to about 95 acres at the present time. The former pleasure-grounds are now developed and known as the Arboretum. In 1875, on the retirement of Sir J. D. Hooker, who succeeded his father in 1865, Sir William Turner Thistle-Dyer was appointed director. The present director is Lieut.-Col. Sir David Prain.

In scientific matters the power of the Director of Kew is absolute, but in matters of administration, he is under the governmental Board of Agriculture. The library consists of about 20,000 volumes, over one-half

of which are set apart, primarily in the office of the Keeper of the museums.

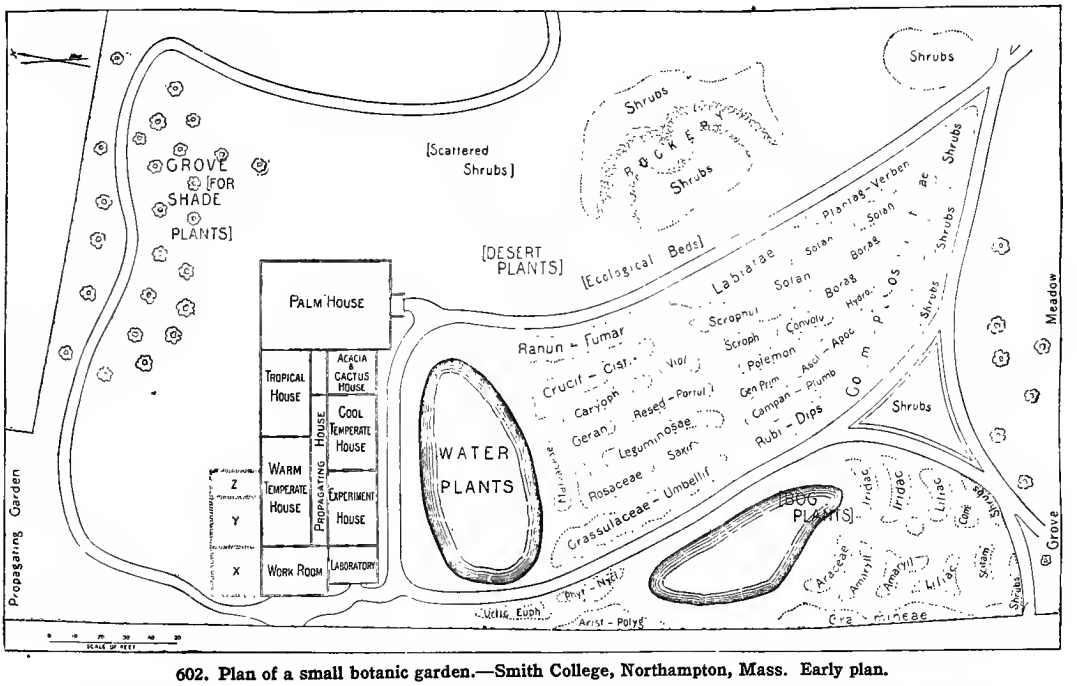
Kew has throughout exerted a profound influence on the development of botanical science, and by the training of gardeners, and in numerous other ways, has forwarded and really made possible the development and work of the numerous colonial gardens and botanic stations. The latter are in reality experiment stations, and while administered by the colonial office, depend upon Kew for scientific advice and for much economic plant material. Consult *Arboretum*.

5. Royal Botanic Society's Gardens (1740). Special mention should be made of the Royal Botanic Society's Gardens at Regent's Park, London, since so much attention has been given there to the various aspects of horticulture. Prior to being taken over by the Royal Botanic Society, about 1840, the area of the garden was occupied by a nursery. Originally flat and circular in outline, it has been given, by artificial treatment, a diversified topography, and the plantations include an

A practical gardening school was established in 1897, and in 1902 a laboratory building was erected for the use of the school. A portion of the grounds is also set aside for this school, and the head of the gardening staff is the chief instructor in the gardening school. Occasional exhibitions are given to illustrate the nature-study work of local schools.

The work of the garden in supplying study-material for schools is unusually extensive, from 50,000 to 60,000 specimens of living plants being supplied annually to students. Several hundred students' tickets are issued each year by teachers in various schools. These tickets admit the bearer daily until three o'clock, after which hour the garden is closed to all except Fellows and other visitors.

The grounds are leased from the Crown, and the money for this and other purposes is derived entirely from private subscriptions by Fellows of the Royal Botanic Society. On this account provision is made to provide attractions for those not primarily or entirely



602. Plan of a small botanic garden.—Smith College, Northampton, Mass. Early plan.

American garden (which is said to be now restricted to a planting of rhododendrons), an herbaceous garden, and an economic garden. Much attention is given to the growing of medicinal plants. An arboretum was started, but eventually abandoned on account of the small area.

The arrangement of plants in the herbaceous garden is that devised by Marnock, the first curator, and the one who planned the entire garden. Each of the different-shaped beds is devoted to one family of plants, so that the relative size of the families is seen at a glance, and beds of nearly related families are grouped together. The economic division comprises trees and shrubs, but the economic herbaceous plants are included in the general herbaceous garden. This is the most extensive exhibit of economic plants grown in London, and it is said that the first banana ever tasted by the late Queen Victoria came from a plant in this garden.

The main part of the conservatory, built in 1845, was the first large plant-house of glass and iron to be erected in England. The system of heating is that of hot water, and the pipes are underground, but this arrangement has not proved to be economical.

interested in botany. The attractions include a tennis-court, croquet-ground, flower-shows, garden fêtes, and a club-house.

There is a set of meteorological instruments in the garden, and records of barometer, wet- and dry-bulb thermometers, temperature of the soil at depths of 1 foot and 4 feet, maximum temperatures in sun and shade, minimum temperatures in shade and "on grass," precipitation, wind direction (but not velocity), duration of sunshine, and general remarks are published in the Botanical Journal of the Society. This journal, issued quarterly, is now (1912) in its second volume.

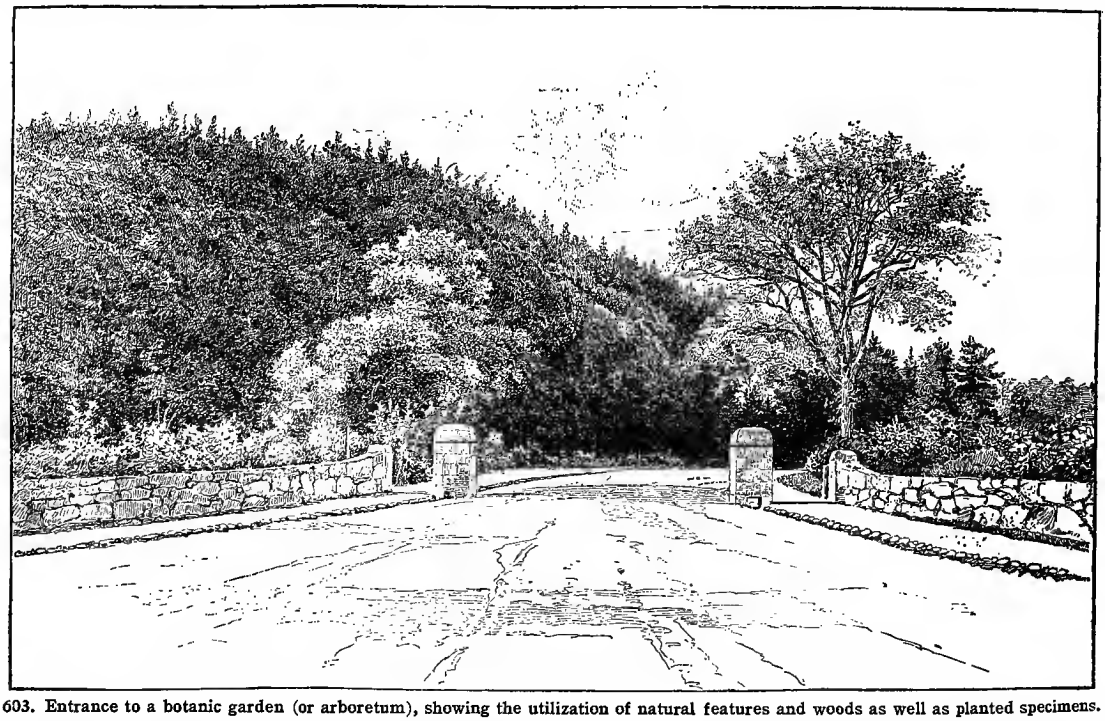
6. Buitenzorg (1817). The botanic garden at Buitenzorg is known officially as 's Lands Plantentuin (Botanic Garden of the State). Its Latin name, "Hortus Bogorensis," is derived from Bogor, the native name of Buitenzorg. The garden is a division of the governmental Department of Agriculture of the Dutch East Indies, and has been described as the most beautiful botanic garden in the world. It was established in 1817 by Reinwardt, and is located 36 miles from Batavia. This location was fortunate for climatic rea-

sons, for while on the Java east coast there is a drought season of three to four months, there is no drought season at Buitenzorg. The total annual precipitation is between 180 and 200 inches, or approximately five times that of New York State. The incessant rains are accompanied by a general lowering of the temperature, and this makes possible the cultivation of plants from the higher altitudes. The altitude of Buitenzorg is 900 feet. There are in reality three gardens: First, the botanic garden proper, in the center of the city, with an area of 89 acres. Each division of this garden has a blanket label, giving a list of the genera it contains, and each species is represented by two specimens, one of which bears a label, giving the scientific name, the common name, if there is one, and usually the economic products of the plant. The climbing plants are arranged systematically in a group by themselves. The vast majority of plants are arborescent, and there are about 10,000 species cultivated. The garden is open day and night. The second division is the agricultural garden, about a league from the center of Buitenzorg, and having 173 acres. Only plants of economic importance, including medicinal plants, are grown here. The third division or garden is some distance from Buitenzorg, on the slopes of the volcano of Gede. Its area is 74 acres, and its altitude is 5,000 feet, thus making possible the cultivation of plants that cannot be grown in the other two gardens. There is a museum building in connection with the garden proper at Buitenzorg.

"The Annals," the well-known publication, was founded by the third director, Scheffer.

American gardens.

1. Bartram's Garden (1728). The first botanic garden in America was that of John Bartram, established in 1728, and still existing, although in a greatly modified form. At about the same date (1725), Robert Prince, one of the early settlers on Long Island, began to raise a variety of trees for the purpose of ornamenting his own grounds, and this activity soon developed into a nursery, ultimately well known, not only in America, but throughout Europe. Such a venture was favored by a growing interest in ornamental and edible plants resulting from the importation of various French fruits by the Huguenots, who settled at New Rochelle, New York, and along the north shore of Long Island. This nursery continued under the supervision of the same family for five generations (130 years). For a number of years the proprietors confined their attention to fruit trees. The institution was visited by President Washington, and on August 29, 1796, after the battle of Long Island, the British General Howe placed a guard around the garden to protect the trees and plants until all danger was passed. In many old English gardens today are numerous native American plants derived from the Prince nurseries. In 1793 the nursery was christened the Linnæan Botanic Garden, and a catalogue of plants here grown passed through more than twenty editions. The mahonias,



603. Entrance to a botanic garden (or arboretum), showing the utilization of natural features and woods as well as planted specimens.

Under the directorship of M. Treub, the garden became a mecca for investigators from all over the world. One large laboratory is reserved entirely for the use of visiting botanists. In the herbarium the sheets are not kept in folios as ordinarily, but in tin boxes, a necessary protection against insects and excessive moisture. There is a library of several thousand volumes. The director distributes annually, under the authority of the government, and free of charge, seeds and plants of useful vegetables.

described in some of the earlier manuals as "from Oregon," are said to have been first grown in the Linnæan garden, being one of the many novelties received from the Lewis and Clark expedition. One of the plant-houses was devoted to camellias, one to azaleas, one to oranges and lemons, one to African and Asiatic plants, and two to miscellaneous collections. The proprietors were ever alert for novelties, and at the time of the potato famine in Ireland, Prince paid $600 for less than a pint of bulbs of *Dioscorea Batatas*, for the pur-

pose of testing them as a possible substitute for the Irish potato. At one time there were over 100 varieties of strawberries under cultivation here, including the once famous Isabella, which originated as a chance seedling or mutant in the garden of Isabella Graham, in Brooklyn. While not a botanic garden in the modern or scientific sense, the Linnæan garden exerted such a profound influence on American horticulture and arboriculture that it should not be entirely passed over in this place.

2. Evans's Garden (1828). The garden of John Evans is located along Ithan Creek, near Philadelphia, within walking distance from Rosemont Station, on the Pennsylvania Railroad. It was established about 1828, and was one of the fruits of Bartram's garden. Evans frequently visited the Bartram garden and other gardens in Philadelphia and vicinity, and became greatly interested in plants. His father was a miller, and the vicinity of the mill, with the creek and mill-pond, and the diversified land adjacent, afforded a wide range of habitat conditions. Evans corresponded with Sir William Hooker and exchanged seeds with him, as well as with the son, Sir Joseph Hooker, including material collected by the latter in the Himalayas. He also had a correspondent in Germany. In Evans's garden the plants were arranged almost entirely on an ecological basis, in "the order of nature," and in this respect it differed materially from most other gardens before or since. Mr. Evans was his own director, curator, and head gardener, doing most of the manual labor in the garden himself. It is of interest to note here that he used sawdust from his father's mill to kill the weeds around the cultivated plants, and this, on decaying, made a rich fertilizer, which was spaded under. The garden is said to have been, in its prime, practically unrivaled in shrubs and trees, and to have had few equals in the richness of its herbaceous material. Many of the trees and shrubs were labeled with lead labels, but no catalogue of the collections was ever published.

3. The Missouri Botanical Garden (1859). The Missouri Botanical Garden, at St. Louis, was established by a gift of money and land from Henry Shaw. It is popularly known in St. Louis as "Shaw's Gardens." On November 6, 1885, Mr. Shaw established the Henry Shaw School of Botany as a department of Washington University, at St. Louis, and the garden and school became closely affiliated. The professor or one of the professors in the school shall be director or director's assistant, or both. The grounds were formerly closed to the public on Sundays, except the first Sunday of June and September, but since 1912 they have been open every Sunday afternoon from April to December. Each year there is preached in a local church a sermon on "the wisdom and goodness of God as shown in the growth of flowers, fruits, and other products of the vegetable kingdom." The first director of this garden was William Trelease, who resigned in 1912, and was succeeded by George T. Moore. The grounds comprise about 45 acres, the herbarium about 800,000 sheets, and the library about 50,000 books and pamphlets. One of the features of the garden is a vegetable-garden, which gives pupils practice in the growing of vegetables, and, by means of a forcing house, this work is continued throughout the year. The best-known publication is the Annual Report. "The Missouri Botanical Garden Bulletin," established in January, 1913, will hereafter contain the annual reports of the officers of the board and the director, while the volume hitherto known as the "Annual Report" will in the future be devoted exclusively to the results of scientific research carried on at the gardens.

4. Elgin Botanic Garden (1801). The first botanic garden in New York City was located on Murray Hill, about 1656, and was the precurser of the Elgin Botanic Garden, established in 1801, by David Hosack, on 20 acres of ground, located at what is now the northwest corner of Fifth Avenue and 47th Street. This garden was transferred to New York State in 1810, and became known as The Botanic Garden of the State of New York. It was later transferred to Columbia University, but finally abandoned for lack of funds. In the spring of 1913 the area was sold by the university for $3,000,000.

5. New York Botanical Garden (1894). The present New York Botanical Garden, established in 1894, is located at Bronx Park, in the Borough of the Bronx, New York City. It comprises an area of approximately 250 acres, and besides two extensive ranges of plant-houses, a range of six propagating-houses and the plantations, includes the largest purely botanical museum in the country, if not in the world. On the third floor of the museum building are located the herbarium, library and laboratories. The grounds, conservatories, and museum are open daily without charge. The present Director-in-Chief, N. L. Britton, is also Professor of Botany in Columbia University, and has served since the foundation of the institution. Under the auspices of this garden, the director and members of the staff have conducted a systematic exploration of continental and insular America, the results of which are being embodied in the "North American Flora," the most extensive botanical work ever undertaken in America, appearing at intervals in fascicles or parts. The herbarium, composed of the herbariums of Columbia University, the Torrey Botanical Club, and that of the garden proper, contains over 1,500,000 specimens, and the library has over 40,000 volumes and pamphlets. The scientific policy of the institution is directed by a Board of Scientific Directors, and the financial administration by the Board of Managers of the Trustees. The scientific staff comprises (1912), besides the director-in-chief, an assistant director, a head curator, four curators, two assistant curators, head gardener, director of the laboratories, bibliographer, librarian, and other officers. Free public lectures on botanical and closely related subjects are given on successive Saturday afternoons, and the following publications are issued: "Journal" (monthly), "Mycologia" (bi-monthly), "Bulletin" (irregularly, and containing the Annual Report), "North American Flora," Memoirs, and Contributions. The Garden is supported by municipal and by private funds.

6. Brooklyn Botanic Garden. The Brooklyn Botanic Garden, established in 1910, is a department of The Brooklyn Institute of Arts and Sciences, and an outgrowth of the work of the Department of Botany of the Institute. It was the wish of the founders to develop an institution that, in connection with research, would place more than usual emphasis upon formal instruction in botany. It is also the intention to emphasize chiefly departments of botany other than taxonomy, such as plant physiology and ecology, morphology, and pathology, experimental evolution, and plant-breeding. The first and present director is C. Stuart Gager. The new laboratory and instruction building, in process of erection (1912), will contain offices of administration, several large laboratories, a small herbarium room, a library, physiological and photographic darkrooms, and twelve private research rooms. A range of plant-houses is also under construction. The grounds comprise about 43 acres, located in the heart of the borough of Brooklyn. Through the center runs an artificial brook, with swamp. The plantations are classified under ten heads, as follows: (1) Systematic Section, comprising hardy herbaceous plants, chiefly perennials, not native within 100 miles of the Garden, and arranged in beds according to their natural affinities. (2) Local Flora Section (Native Wild-flower Garden), containing herbaceous and woody plants growing without cultivation within a radius of 100 miles of the Garden (the Torrey Botanical Club Range). The strictly native

sorts are designated by labels of different color from those of introduced species. (3) Morphological Section, with divisions of (*a*) External Anatomy and (*b*) Comparative Morphology. (4) Ecological Section, adjacent to and including the swamp section of the brook and extending back to include a dry knoll. Here is illustrated the adjustment of plants to environmental influences. (5) Evolution Section, illustrating such subjects as variation, inheritance, artificial and natural selection (including the origin of horticultural forms), struggle for existence, and survival of the fittest. (6) Economic Section with divisions of (*a*) Foods and Condiments, (*b*) Medicinal and Poisonous Plants, and (*c*) Fiber Plants. (7) Weed Section, to show the botanical characteristics of weeds, as bearing on their economic significance. (8) Formal Garden Section, in front of the laboratory building and greenhouses, and serving to illustrate the uses of plants, chiefly horticultural, for purely ornamental purposes. (9) Arboretum, a collection of trees, chiefly native. (10) Fruticetum, a collection of shrubs, both native and exotic. The arboretum and fruticetum features are developed in close connection with the other sections, and in the systematic garden the aim has been to group the shrubs and trees as near as practicable to the herbaceous material with which they are most closely related. The willows and alders are grown along the brook.

The Garden issues an administrative quarterly, "The Brooklyn Botanic Garden Record" (the April number of which contains the Annual Report), Contributions, and Guides. A series of Memoirs and of Educational Leaflets is also projected. Admission to the grounds is free daily, including Sundays and holidays, from 8 A.M. until sunset. The Garden is supported by annual municipal appropriations, by the income from an endowment, amounting at present to over $50,000, and by gifts.

Suggestions from the foregoing.

As may be inferred from what has preceded, the history of botanical gardens has shown a steady progressive development from collections of medicinal herbs, gathered and studied with reference to their economic uses, to institutions endeavoring to maintain collections of all kinds of plants, both herbaceous and woody, some ornamental and useful, but perhaps most of them collected and studied for their own sake, from the standpoint of pure science, with an endeavor to understand the nature as well as the uses of plants. The Chelsea Garden affords a concrete illustration of this, for while the collections here were at first almost entirely confined to medicinal plants, these now form only a comparatively small portion of the collections. In this way, and in this way only, may botanical science be most rapidly and most surely advanced, to the advantage not only of pure science itself, but of horticulture, agriculture, forestry, pharmacology, and all phases of applied botanical science.

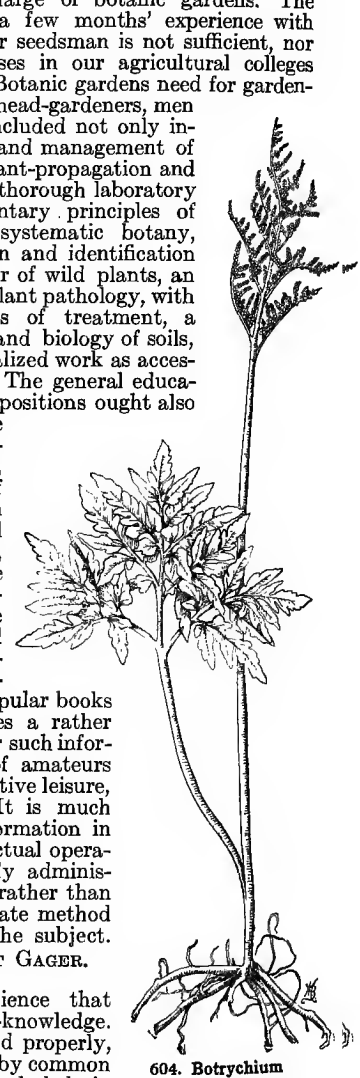
It was one of the marks of greatness and of sound judgment of Sir William Hooker, that he aimed definitely to make Kew Gardens not only a scientific institution of the first rank, but to make them beautiful,—attractive to the general public. This latter aim has been too often neglected or minimized, on the theory that a botanic garden is a scientific institution, and should, therefore, be developed with little regard for the non-scientific public. This is an unfortunate and unfair attitude, unfair to the general public, especially in those gardens which are supported in part by public money, and unfortunate for botanical science because it not only neglects a very important aspect of botany—applied botany,—but loses the opportunity of enlisting the intelligent sympathy of the community with botanical endeavor. Many persons who might otherwise remain quite indifferent to botanical work in general, or even to the work of a given garden in particular, may, through being attracted primarily by the beauty of the collections and grounds, be led to give generous support to such work, or even to discover that their own main interest is botany, and ultimately to advance the science by their own studies.

It is unfortunate that the United States government has no national garden to do for our own country what Kew has done for England. The climate and location of Washington combine to make the capital city an admirable place for the development of a botanic garden, and two or three branch gardens could be established to advantage in parts of the country, giving wide diversity of climatic conditions, such as one of the extreme southern states, the great American desert, and one of the most northern states.

With only very little additional expense, many city parks could be made more interesting and instructive, and none the less beautiful and attractive, by giving potions of them more the character of a botanic garden, at least by suitably labeling the trees and shrubs and growing them with some regard to botanical affinities.

With the exception of the Missouri Botanical Garden, there is nowhere offered in the United States a thorough course of study for the purpose of training gardeners to take charge of botanic gardens. The training received in a few months' experience with a commercial florist or seedsman is not sufficient, nor do horticultural courses in our agricultural colleges answer the purpose. Botanic gardens need for gardeners, and especially for head-gardeners, men whose training has included not only instruction in the care and management of greenhouses, and in plant-propagation and cultivation, but also a thorough laboratory course in the elementary principles of botany, a course in systematic botany, including the collection and identification of a minimum number of wild plants, an elementary course in plant pathology, with emphasis on methods of treatment, a course in the physics and biology of soils, and also in such specialized work as accessioning and labeling. The general education of men for these positions ought also to be such as to enable them to express themselves well in writing, and to give courses of instruction to others in the various practical phases of their work, such as greenhouse economy, plant-propagation, and the care of herbaceous and woody plants out-of-doors. The recent success of a number of popular books on gardening indicates a rather widespread demand for such information on the part of amateurs and people of comparative leisure, as well as others. It is much better to get this information in connection with the actual operations of a scientifically administered botanic garden, rather than by the wholly inadequate method of reading a book on the subject.

C. STUART GAGER.



604. Botrychium obliquum. (×½)

BOTANY. The science that treats of plants; plant-knowledge. In its widest sense, and properly, it includes much that, by common consent, is usually included in

horticulture,— as amelioration of plants by domestication, hybridizing, and the like. Horticulture is a part of the large conception of botany, so far as its scientific aspects are concerned.

BOTRÝCHIUM (Greek, in allusion to the grape-like sporangia). *Ophioglossàceæ*. A genus of mostly temperate plants allied to ferns, with fleshy roots, short underground sts., each of which bears a single free-veined lf., consisting of a short petiole, a usually triangular, divided blade, and a single erect panicle bearing the fleshy sporangia.

These plants may be grown in the hardy border, or against a building on the shady side. They require no special treatment. They are little cultivated, but are of interest to the collector or fancier.

A. *Petiole as long as the fertile portion.*

virginiànum, Swartz. MOONWORT. Six in. to 2 ft. high, with a broad, triangular blade, with 3 main triquadri-pinnatifid divisions: fertile portion long-stalked. E. U. S.—The only species large enough to make a display.

AA. *Petiole much shorter than fertile portion.*

obliquum, Muhl. Fig. 604. Plant, 6–15 in. high, with a ternate blade 2–6 in. wide: segms. obliquely ovate or oblong, ½–¾in. long: fertile part long-stalked. (*B. ternatum*, Authors, not Swartz, which latter is a different Japanese species.) E. U. S.

dissèctum, Spreng. Plant, 6–18 in. high, with a ternate, finely dissected blade, 3–8 in. wide, the ultimate divisions $\frac{1}{16}$in. or less wide. E. U. S.—Evergreen; delicate and graceful. Grows in woods and meadows.

R. C. BENEDICT.

BOTTLE-BRUSH: *Metrosideros*; also *Callistemon* and *Melaleuca*.

BOTTOM HEAT. Soil temperature that is higher than that of the superincumbent air. Most tender plants require to have the roots warmer than the tops, particularly when grown under glass.

BOUGAINVÍLLEA (De Bougainville, 1729–1811, a French navigator). *Nyctaginàceæ*. South American shrubs, often climbers, with very gaudy large bracts, grown under glass, and as arbor plants South.

Leaves alternate, petioled, entire: fls. small and inconspicuous, tubular, the margin 5–6-lobed; stamens, 7–8, on unequal capillary filaments; ovary stipitate. The small and inconspicuous fls. are inclosed with large and showy magenta-purple or red bracts that constitute the decorative value of the plants. Two more or less scandent species are chiefly known in cult. Less than a dozen recognized species.

The bougainvilleas have been much grown of late as pot-plants. The young stock (started from cuttings) may be grown in the field and be lifted in early autumn; this will produce plants for spring bloom but not for early flowering. For earlier bloom, the plants may be carried through the summer in pots. Half-ripened or old wood, in 6- to 12-inch lengths, may be used for cuttings in April to June. The subsequent culture is simple. For glasshouse work the plants may be kept cut back and the branches trained. In California, Florida, and other southern regions, bougainvilleas are plentifully used as porch-covers, where they make a most brilliant show. Not hardy.

The cultural requirements of the bougainvilleas are of the easiest. They thrive in almost any kind of soil and should be grown in full sunshine. *B. glabra* and its varieties are the best for ordinary purposes, as they bloom when small, and thrive readily in a cool greenhouse or in the open where free from frost. *B. spectabilis* and its var. *lateritia* require more tropical conditions and reach large dimensions. All are readily propagated, and will root in a few weeks from cuttings of the young shoots a few inches in length and placed in sandy soil in bottom heat and moisture at a temperature of 65° or 70° F. *B. glabra* and its varieties make most excellent pot-plants, either as large or small specimens. They are also valuable for summer bedding. All the kinds make very desirable subjects for clothing verandas, arches and pergolas or for planting at the base

605. Bougainvillea glabra. (×½)

of trees (where the climate is suitable for outdoor culture), which they will rapidly clothe in a mass of most beautiful and highly colored flower-bracts. Another and most effective purpose to which these plants can be put is that of hedge or fence plants in tropical and subtropical countries. They stand drought exceedingly well and may be pruned with impunity. (C. P. Raffill.)

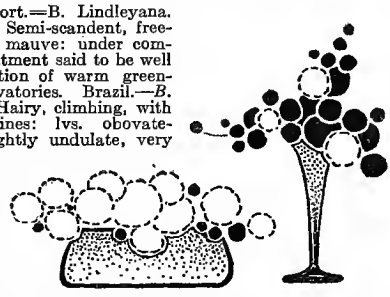
glàbra, Choisy. Fig. 605. Grows 10 and more ft. high and wide, when planted in the ground and allowed to have its way; glabrous: lvs. ovate and acuminate, glabrous and bright green: bracts cordate-ovate, bright rosy red, distinctly veined. Brazil. G.C. III. 23:168; 30: 265. Gn. 54, p. 257; 64, p. 353. R.H. 1889:276. A.G. 16:15. A.F. 11:1371. F.E. 10:106.—Free-flowering and handsome; often grown in pots and kept dwarf. Var. **Sanderiàna,** Hort. Very floriferous, blooming even in very small pots. Gn. 45:418. A.F. 10:307; 11:977; 12:1185. Gng. 4:281; 5:345. G. 27:457.—A very worthy plant both for pot culture or as a shrub or climber. Often blooms when 1 ft. high, but reaches a height of 10–20 ft. Var. **Cỳpheri,** Hort. A much larger and finer plant than the type; the large and bright-colored deep rose bracts are freely produced in long plumose clusters on all the principal growths, and are more highly colored than those of the var. *Sanderiana*. It may be treated the same as var. *Sanderiana* as to cult. It is an acquisition as a decorative plant. Var. **variegàta,** Hort. Lvs. prettily variegated with creamy white; useful as a neat and quick-growing foliage plant for summer bedding.

spectábilis, Willd. (*B. speciòsa*, Lindl. *B. splèndens*, Hort.). Taller and stricter, with larger and thicker lvs., hairy: fls. in large panicles; bracts larger, deep rose-color, but varying to purple and greenish. Brazil. B.M. 4810, 4811. P.M. 12:51. I.H. 42:30—An immense and strong-growing climber, rising by means of numerous stout hooked spines. Variable; known also as *B.*

brasiliensis, *B. bracteata* and *B. peruviana*. Var. laterítia, Lem. (*B. laterítia*, Hort.), has brick-red bracts. I.H. 13:466. More showy than the last when in full bloom; perhaps distinct; said to be more difficult to start from cuttings than the type, at least without bottom heat.

B. aurantiaca, Hort.=B. Lindleyana. —*B. formòsa*, Bull. Semi-scandent, free-flowering: purplish mauve: under comparatively cool treatment said to be well adapted for decoration of warm greenhouses and conservatories. Brazil.—*B. Lindleyàna*, Hort. Hairy, climbing, with strong curved spines: lvs. obovate-rounded, acute, slightly undulate, very hirsute: bracts elliptic, short-acuminate, cinnabar-color.—*B. refúlgens*, Bull. Lvs. pubescent: racemes long and drooping, and bracts purple. Brazil. Apparently a less valuable and shy-flowering form of *B. spectabilis*.

L. H. B.



606, 607. Flower theme (at the left) and foliage theme (at the right). In Figs. 606-616, the outline circles represent flower masses, and the black circles foliage masses.

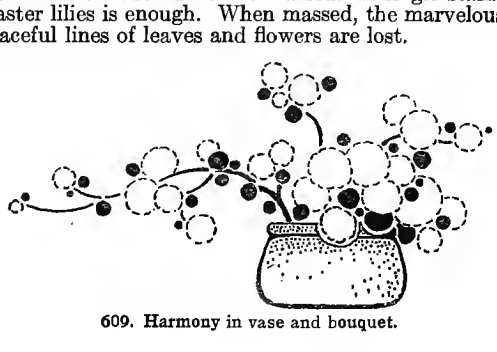
BOUQUETS. The aim in flower-arrangement is beauty: (1) A display of the natural beauty of the plant, or (2) the creation of a beautiful group of floral material.

608. Harmony in vase and bouquet.

(1) Plant beauty combines two chief elements: color and form. In such plants as the pansy, the peony, and the full-blown rose, color is the dominant element. In such plants as the calla, the Easter lily, and many of the orchids, form is the dominant element. In some flowers, as rosebuds, nasturtiums, and chrysanthemums, the two elements are so nearly balanced that either one may be selected for special display. In any case, one element, color or form, should predominate in the arrangement. Plate XVIII shows at *a*, the yellow-centered daisy massed to emphasize its beauty of color; *b* shows the same flower arranged to display its beauty of form. A single clump of the plant has been transplanted to a bowl, that its wayward natural growth in the midst of the grasses may be enjoyed.

In some cases the flowers may be the theme. The arrangement then becomes similar to Fig. 606. (In all the figures the dotted circles indicate flower masses, and the solid black circles, leaf masses.) In others the foliage may be worthy to become the theme, or may be used as a foil to bring out more clearly the exquisite grace or hue of a few flowers. In such a case Fig. 607 represents the type of arrangement. Foliage and flowers should never vie with one another for first place.

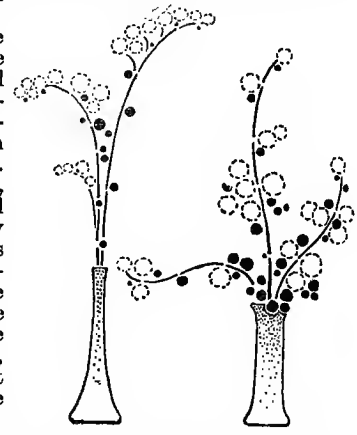
Color flowers may be massed. The bigger the bunch of peonies, the more impressive and splendid is the color. Form flowers should not be massed. A single stalk of Easter lilies is enough. When massed, the marvelously graceful lines of leaves and flowers are lost.



609. Harmony in vase and bouquet.

Receptacles should always be less attractive than that which they hold. Brilliant colored vases, those with gilding, cut glass, vases decorated with pictures, or with flowers modeled in high relief or represented in color, are all to be avoided. They are too obtrusive. They force the flowers to take second place. Receptacles of clear glass which take on the color of the stems put into them, of dull soft colors, of unpolished metal, are likely to be most serviceable in displaying the natural beauties of flowers.

The receptacle should be of the shape best adapted to holding the flowers as nearly as possible in the position in which they grew. In Plate XVII at *d*, the broad bowl (full of pebbles to steady the stems) makes possible such an arrangement for the apple blossoms. The tall vase with the narrow neck, at *c*, insures the right position for the spray of bayberry.

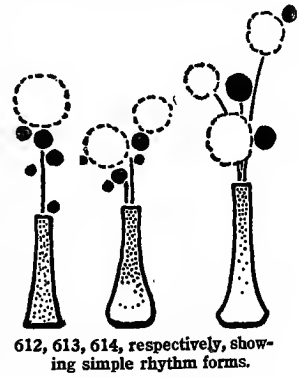


610, 611. Simple and reversed curves.

Of course the natural beauty of a plant cannot be displayed to advantage when confused with other plants. This is the reason for the general rule: Use in a bouquet only flowers of one kind, with their own foliage.

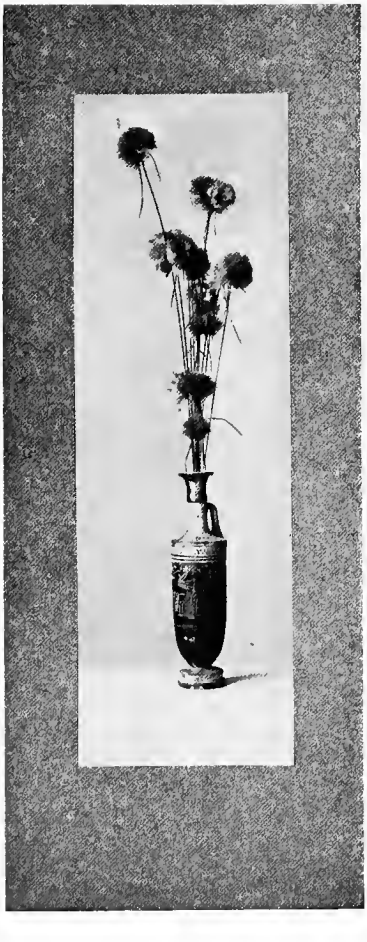
(2) Beautiful groups of plant forms present, (*a*) unity, (*b*) rhythm, and (*c*) balance.

(*a*) An arrangement has *unity* when all the parts of which it is composed are so related that the whole makes its appeal to the eye first. All the parts must have something at least in common to bind them together. In nature the common element may be *texture*, as in the snakeroot; *color* as in the mullein; *line* as in the goldenrod. In flower-arrangement the receptacle must have some element in common with the plant; in *a* (Plate XVIII) the color of the jar echoes the color of the flowers; in *b* both the color and the ornament of the bowl echo the character of the sod; in *d*, the shape of the bowl echoes the shape of the apple blossom and its color echoes their color. In *c*, the shape of the vase echoes the shape of a bayberry leaf; its contours echo the lines of the stems; its pattern echoes the speckle of the bayberries; and the dark stand gives the receptacle a color repeating the dark color of the leaves. The receptacle must have something at least in common with the plant, but must never vie with it in any way. If the bouquet is tall and slim, the vase may have similar form (Fig. 608); if it is short and broad, the vase may repeat that shape (Fig. 609). In Fig. 610, the sprays have one line in common, a simple forceful curve repeated in the vase. In Fig. 611, the sprays have the reversed curve in common, echoed softly in the vase.



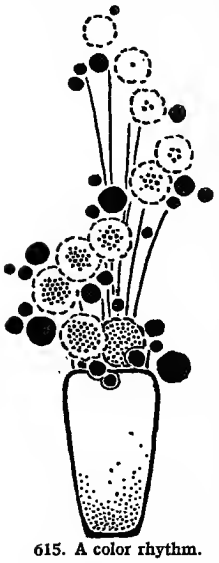
612, 613, 614, respectively, showing simple rhythm forms.

(*b*) *Rhythm* means orderly variety of some kind. Fig. 612 exhibits orderly variety in the sizes of leaves, all subordinate to the one flower. Such an effect can always



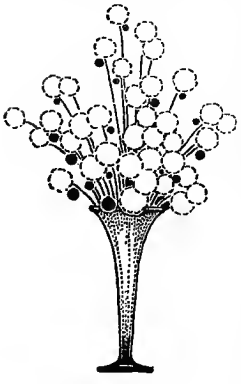
XVII. The arrangement of bouquets.

be produced by pruning the spray. Fig. 613 shows an orderly variety in sizes in both leaves and flowers. The parts are in pairs, a larger and a smaller composing each pair, like march time in music. Fig. 614 shows an orderly variety in which each set is composed of a series of three, large, smaller, smallest,—something like a three-part measure, waltz time, in music. Figs. 610 and 611 show rhythm of measure in the lengths of the sprays and rhythm of line in their curves. In each case there are three similar curves, but three which form a series from least bent to most bent. Fig. 608 presents a rhythm of measure in the sizes of the flowers, another in the sizes of the leaves, and another in the lengths of the stems. Fig. 615 shows a rhythm of color. When flowers of one kind present a wide range of tone,—pinks, for example, running from white to red through various tones of pink, they may be arranged agreeably by making evident the rhythm of color from lightest to darkest. When the flowers vary in hue as nasturtiums do, from yellow through orange to red, a rhythm of hue may be established in a similar way. Such sequences of color (unless too formal) are always more pleasing than haphazard spottings of color. All these arrangements show rhythms of mass. Fig. 608, 610, and 611 show a triple subdivision, large, smaller, smallest, but not so disconnected as to destroy the unity of the whole in any case. Figs. 609, 615, and 616, show more complex rhythms of mass, but in a general way they present a simple movement from the diffuse to the compact. This the eye can take in at a glance. Each review of this rhythm gives additional pleasure to the sense of sight. A rhythm, an orderly sequence of some kind, for the eye to follow, is essential in floral arrangement.



615. A color rhythm.

(c) *Balance.*—A flower-arrangement must not be too formal. It must present something of the freedom of wild nature but it must appear to be in stable equilibrium. Every spot, every color, every stem line, every space between these elements, presents an attraction for the eye. All these attractions must be adjusted to one another so that the whole appears to stand securely. This means that the parts must be disposed with reference to the vertical center line of the vase. The principle is that of the steelyard. A large, a brilliant, a solid mass, near the center line, may be balanced by a small, a dull, or a diffuse mass, farther removed from the center line. To appear free, like nature, the attractions on one side must not duplicate, in form, size or position, the masses on the other. Such an arrangement is formal, and belongs in the realm of structural and conventional art; but, however varied the elements may be, they must be so disposed as to counterbalance each other, and maintain the balance of the whole. Compare the illustrations with this principle in mind.



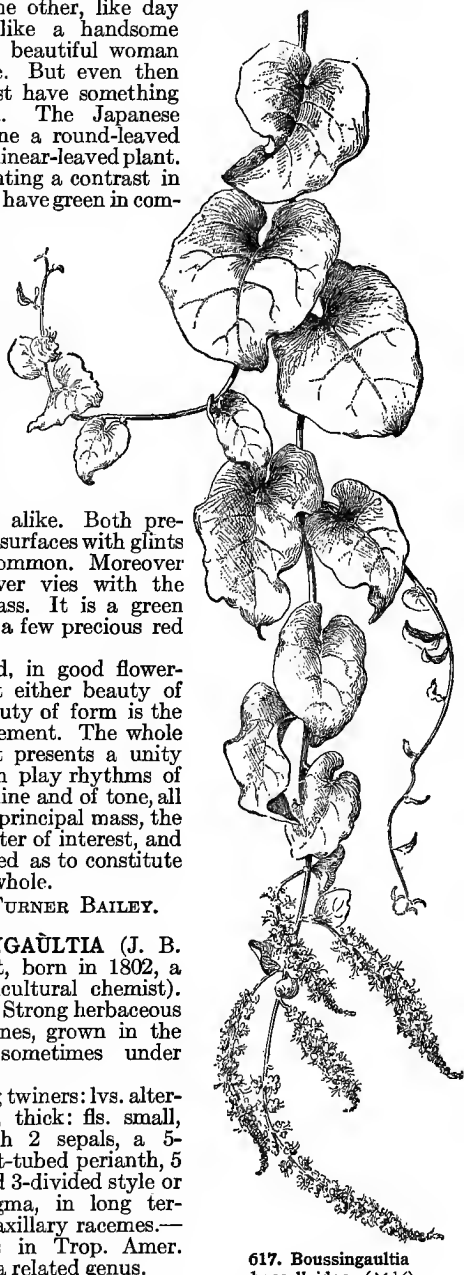
616. Complex rhythm of mass.

Lovers of natural beauty do not overlook the possibilities of winter bouquets. Sprays of seed packs, withered leaves, and the like often present soft dull colors in such harmonious groups of tones that they may serve as models for color schemes for costumes and the interior decoration of rooms. They often present exquisite rhythms of measure, subtle refinements of line, charming combinations of erratic curves, and surprising oppositions of harmoniously related details, unrivaled in the growing period of the plant's life. Plate XVIII shows at *e* a picturesque spray of white oak with "oak apples."

More than one kind of plant may be used in an arrangement, provided the beauty of one enhances the beauty of the other, like day and night, like a handsome man and a beautiful woman side by side. But even then the two must have something in common. The Japanese often combine a round-leaved plant with a linear-leaved plant. While presenting a contrast in form the two have green in common. Nature often combines strong contrasts, as in the dark green holly with its bright red berries. While the colors are complementary, the textures are alike. Both present smooth surfaces with glints of light in common. Moreover the red never vies with the green in mass. It is a green spray, with a few precious red dots.

In a word, in good flower-arrangement either beauty of color or beauty of form is the dominant element. The whole arrangement presents a unity within which play rhythms of measure, of line and of tone, all related to a principal mass, the supreme center of interest, and all so disposed as to constitute a balanced whole.

HENRY TURNER BAILEY.



617. Boussingaultia basselloides. (×⅓)

BOUSSINGAÙLTIA (J. B. Boussingault, born in 1802, a famous agricultural chemist). *Basselldceæ*. Strong herbaceous perennial vines, grown in the open and sometimes under glass.

Branching twiners: lvs. alternate, entire, thick: fls. small, perfect, with 2 sepals, a 5-parted, short-tubed perianth, 5 stamens, and 3-divided style or 3-lobed stigma, in long terminal and axillary racemes.—Ten species in Trop. Amer. Anredera is a related genus.

baselloïdes, HBK. MADEIRA VINE. MIGNONETTE VINE. Fig. 617. Perennial, root tuberous: sts. smooth, reaching 10–20 ft. in a season, and in late summer or fall bearing profusely of the fragrant white fls. (which become nearly black with age), and producing little tubercles by means of which the plant is prop. Ecuador. B.M. 3620.—A common

vine, prized for porches and arbors. The roots are stored in the winter, and planted out after danger of frost is past. The plant will not endure frost. Sometimes grown in the conservatory and window-garden. It has run wild in Fla. and Texas. L. H. B.

BOUVÁRDIA (Charles Bouvard, 1572–1658, physician to Louis XIII, and Superintendent of Royal Gardens in Paris). *Rubiàceæ.* Handsome greenhouse flowering shrubs, once popular as florists' plants.

618. The common garden form of Bouvardia. Cluster from a side growth.

Small shrubs (rarely perennial herbs), with simple, sometimes verticillate, lvs. and subulate stipules: fls. in terminal cymes, showy, in red, yellow and white; calyx 4-lobed, the lobes persistent; corolla long-tubular or salver form, with 4 spreading lobes; stamens 4, alternate with corolla-lobes and attached in the tube or throat; styles inserted or exserted in different fls., the stigmas 2; ovary 2-celled: fr. a loculicidal caps.—About 30 species, from Texas and Ariz. to Colombia and southward, chiefly in Mex. and Cent. Amer.

Bouvardias were once very important florists' flowers, but they have now given place, along with camellias and others, to chrysanthemums, carnations and other plants. The plants have such merit in themselves, however, and are so likely to return to favor in this country, that a rather full cultural treatment is here given. The bouvardias of florists do not represent any of the type species. They are sports, hybrids, and other types of variations. The Latin-form names in American trade catalogues nearly all belong to these garden forms. The species which are of most importance to the horticulturist are mentioned below:

A. *Fls. in shades of red.*

B. *Lvs. normally in 3's (except, perhaps, on the branchlets).*

triphýlla, Salisb. (*B. Jácquinii,* HBK.). Small pubescent shrub, 2–6 ft. high: lvs. in 3's or 4's (or opposite on the branchlets), lanceolate to lance-ovate, glabrous above: fls. an inch long, pubescent, bright scarlet. Mex. and reaching north to Ariz. B.M. 1854;3781 (as *B. splendens,* Graham).—The genus Bouvardia was founded upon this species, which was intro. into England more than 100 years ago. It is evidently the most important parent strain, although it is probably not in cult. in its original form. Figs. 618 and 619 partake very strongly of this species. In fact, Fig. 618 compares well in botanical characters (except less long-pointed lvs.) with the early pictures of *B. triphylla.*

leiántha, Benth. Much like *B. triphylla;* more bushy and better grower: sts. hairy: lvs. hairy above: fls. glabrous. Mex. R.H. 1851:81.—Perhaps only a form of the preceding. It is said that the first recorded hybrid bouvardia appeared about 1857, with Mr. Parsons' nurseries at Brighton, England, being between *B. leiantha* and *B. longiflora.* Many secondary forms have come from this cross, some of them being white, as *B. Davidsonii* or *B. Vreelandii* (G. 27:632).

Other red-fld. 3-lvd. species are: *B. angustifòlia,* HBK. Lvs. lanceolate, revolute, glabrous above and fine-pubescent below: branches nearly glabrous. Mex. *B. hirtélla,* HBK. Very similar: lvs. pubescent on both surfaces. Mex. *B. scàbra,* Hook. & Arn. Lvs. ovate, short-stalked: fls. large, in dense clusters, pink: st. hairy. Mex.

BB. *Lvs. opposite.*

Cavanillesii, DC. (*B. multiflòra,* Schult.). Hairy: lvs. ovate-acuminate, broad at base, short-stalked, edges hairy: fls. 1½ in. long, very slender, glabrous. Mex.

AA. *Fls. yellow.*

flàva, Decne. Lvs. opposite, ovate-lanceolate or lance-elliptic, very short-stalked, ciliate: fls. very long drooping, in 3–5-fld. racemes, bright yellow. Mex. F.S. 1:43.

AAA. *Fls. white.*

longiflòra, HBK. Glabrous, branching shrub: lvs. opposite, ovate-acuminate, stalked: fls. 1½–2 in. long, with a very slender tube and a wide-spreading, large limb, 2 or 3 together and aggregated into a terminal cyme. Mex. B.M. 4223. F.S. 2:123.

Húmboldtii, Hort. Lvs. opposite, ovate-acuminate: fls. very large, fragrant, in a large, terminal cluster. G.C. 1873:717. G. 27:331 (var. *grandiflora*).—This is a choice conservatory plant. It is usually catalogued as *B. Humboldtii corymbiflora.* Blooms from summer to winter. Probably a derivative of *B. longiflora. B. candidissima,* Hort., white-fld., is said to be a hybrid, with *B. Humboldtii* as one of its parents.

jasminiflòra, Hort. Compact and dwarf, very floriferous, the fls. in close, terminal clusters. G.C. 1872:215. —Probably a derivative of *B. longiflora.* L. H. B.

All the cultivated species and varieties of bouvardia are evergreen greenhouse plants. They thrive best in a mixture of equal parts of rich turfy loam, leaf-mold and sand, which should be rammed moderately firm but not too hard. They require an abundance of water during the growing season, and, once they have started into growth in the spring, should never be allowed to suffer for the want of water at the roots. A house in which the temperature can be maintained at 55° F. with fire-heat, suits them best, but the temperature may, with advantage, be allowed to run up to 80° or

619. The double-flowered form of the garden Bouvardia. Terminal truss.

90° F. with sunheat, providing they are given an abundance of ventilation at the same time. The plants should be frequently syringed during the growing season to keep down insect pests and to help to maintain a healthful growing atmosphere. All the bouvardias revel in a fair amount of sunshine, and may be described as sun-loving plants, but under glass during the hottest part of the day, it is an advantage to shade them lightly to break the direct rays of the sun. Under this

treatment growth is rapid, and the plants require to be frequently pinched back at the points in order to induce sturdy, well-balanced specimens. If this pinching-back is neglected, the plants will become ill-balanced and few flowers will be the result. The time of flowering can be readily regulated by the time of the last pinching back, and a succession of flowering plants may be maintained practically throughout the whole year. Amongst market-growers, the aim should be to secure the bulk of the flowers in the winter period, for which purpose very little pinching of the shoots should be practised after September, and the plants should then be allowed to grow on until the flowers appear. When in flower, the plants should be removed to a somewhat drier house, and they last much longer if kept in a temperature of about 50° F.

Many growers plant out strong healthy plants upon benches under glass, or in favored situations outdoors. Under these conditions growth is rapid, and if carefully watered and attention is paid to pinching-back the leading growths, fine flowering specimens are quickly secured. For the cut-flower trade, this method has a considerable advantage over pot culture. All through the growing period, it is absolutely essential that the plants should never be allowed to suffer for the want of water and, when well established, they should be fed liberally with manure.

Specimens planted out in the open, should be lifted with a good ball in early autumn, potted up and placed in a close shaded house until the roots again become active. These plants will furnish a large supply of flowers during the winter months.

After the flowering period is over, bouvardias should be kept somewhat cooler and drier at the roots for a few weeks, after which they should be cut back and started again in heat and moisture. If kept frequently syringed, they will soon break freely and furnish a good supply of cuttings. These are best removed with a heel when about 2 inches long, and placed in 4- or 5-inch pots in an open compost of equal parts sand and peat or fine leaf-mold, and placed in a moist and close frame with a brisk bottom heat. Roots are soon emitted, when the plants should be potted up singly and moved on into larger-sized pots as required. Most of the garden varieties are also readily propagated from pieces of the larger and thicker parts of the roots in spring. These may be cut into lengths of about 2 inches and planted the same as cuttings, leaving a small piece exposed above the soil. Adventitious shoots are soon formed on these and soon make good serviceable plants.

The numerous garden forms are all so distinct in habit, shape and poise of the flowers from all the known species, that it is difficult to identify any of them as varieties of any one species. It is probable that they are complex hybrids of *B. triphylla*, *B. leiantha*, *B. Cavanillesii*, *B. scabra* and possibly *B. flava*, all of which species are more or less villose and scentless. The garden forms are extremely handsome, and useful as cut-flowers, for indoor decoration, also for buttonholes and for making up into ladies' sprays, wreaths and so on. Other purposes for which they are largely grown, are the decoration of the greenhouse or conservatory, and, in warm localities, as bedding plants A selection of some of best varieties is given herewith:

Alfred Neuner. Double, pure white fls.; an old variety of great merit; of good constitution. *Bridal Wreath.* White, free-flowering, with large loose trusses; one of the best for cut-fls. *Bridesmaid.* Double, pink fls., brighter than President Garfield. *Brilliant.* Bright crimson, floriferous, and of easy cult. *B. candidissima.* White; an improvement on B. jasminoides. *Dazzler.* Rich scarlet; free and compact-growing. *B. elegans.* Scarlet; large truss of loose habit. *B. flavescens.* Light yellow; distinct; bad habit. *B. flavescens flore-pleno.* Double form of last-named. *Hogarth.* Brilliant scarlet; large truss; a well-known variety. *Hogarth flore-pleno.* Double, scarlet. *B. jasminoides.* White; a free-flowering dwarf form, of easy cult. *King of the Scarlets.* Light-scarlet; large truss of very fine large fls.; a new variety of great merit. *Maiden's Blush.* Light rose; floriferous. *Mrs. Robert Green.* A fine salmon-pink sport from President Cleveland; distinct and beautiful. *President Cleveland.* Brilliant scarlet, with crimson tube; the richest and best of its color, floriferous and of easy cult. *President Garfield.* Double, pink; floriferous; large truss. *Priory Beauty.* Delicate rose or deep pink; one of the most beautiful; elegant habit; medium and compact truss. *Purity.* White; fragrant, free, large fls.; loose truss. *Sang Lorraine.* Bright vermilion-scarlet; double. *The Bride.* White, tinted with pink; one of the best for bouquets, etc. *Thomas Meehan.* Double, bright scarlet, with pale rose-scarlet tube; floriferous. *Triomphe de Nancy.* Double bright orange-red; large truss; distinct. *Victor Lemoine.* Large, very double fls.; brilliant scarlet. *B. Vreelandii* (B. Davidisonii). Pure white; extremely floriferous; a favorite variety in gardens, and of very easy cult. *Vulcan.* Scarlet; medium-sized truss. *White Bouquet.* Pure white; exceedingly dwarf and compact.

C. P. RAFFILL.

620. Bowiea volubilis.

BOWÈNIA (bears the name of Sir Geo. F. Bowen, once Governor of Queensland). *Cycadàceæ.* Zamia-like plant, grown to some extent in Florida and hardy in the central part.

Bowenia, a monotypic genus, differs from Macrozamia in foliage characters and in the absence of a point on the cone-scales; and from Zamia largely in its bipinnate lvs. **B. spectábilis**, Hook. Trunk thick, scarcely rising above ground, plant glabrous: lvs. 3–4 ft. long, loosely bipinnate, each pinna or lft. 1 ft. or more long, the 9–20 segms. ovate or ovate-lanceolate, oblique or falcate, acuminate: cones short-peduncled, the sterile ones 1½–2 in. long and half as thick, the fertile ones 3–4 in. diam., and the scales expanded between the seeds into a broad and thick truncate apex. Queensland, Austral. There is a var. *serrulata*. B.M. 5398, 6008.—This charming little cycad makes beautiful clumps, thriving well under lath houses in Fla., when given proper shade, good supply of moisture and soil rich in humus; the lvs. are easily broken if the plant is roughly handled.

L. H. B.

BOWIÈA (after J. Bowie, collector for Kew). *Liliàceæ.* A monotypic genus containing one of the most curious plants in the vegetable kingdom, sometimes grown under glass as an oddity, and as an illustration to students of botany.

A round, green bulb 4–5 in. thick throws up yearly a very slender, twining fl.-st. 6–8 ft. high, with many compound, forked, curving branches below, and numerous small green fls. above. This branched fl.-stalk is green and performs the function of the usually absent lvs.; somewhat asparagus-like. There are no lvs. except 2 small, linear, erect scales at the apex of the bulb, which quickly vanish. The lvs. show its relation to Drimia and Scilla.

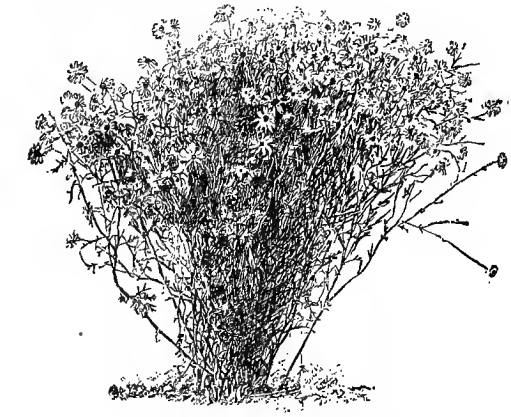
volùbilis, Harv. Fig. 620. Perianth 6-cleft to the base, persistent, green or greenish white, the segms. incurved at the tips, ultimately reflexed. S. Afr. B.M. 5619.—Sold by dealers now and then, and cult. in botanic gardens with cactus-like euphorbias and other curiosities. *B. volubilis* is a remarkable bulbous-rooted twining greenhouse climber. The bulbs grow to be very large, sometimes becoming 19 in. circum. and some 6 or 7 in. deep. The slender, twining vine seems out of proportion to the size of bulb. It does not produce lvs., but the lower part of the vine is furnished with pendulous, abortive panicles which seem to perform the function of lvs. The small insignificant greenish white fls. are borne at the upper end of the vine. This is a useful plant for twining on the supports of a moderately warm greenhouse, and is of the easiest possible cult. Prop. is effected by seeds, or occasionally by the natural division of the bulbs. The season of growth usually begins about the first of Oct., when the bulbs should be repotted in any light, rich soil, and kept well watered until the sts. begin to mature, which usually occurs in May, when water should be gradually withheld, and the plants stored away in some shaded part of the greenhouse and kept quite dry until the season of growth begins again.

WILHELM MILLER.
E. J. CANNING.

BOWKÈRIA (Henry Bowker and sister, botanists in S. Afr.). *Scrophulariàceæ.* South African shrubs of 5 species, one of which is rare in cult. in south of England, and likely to be intro. into this country. Allied to Scrophularia, differing in being ligneous and in technical floral characters. **B. Gerrardiàna,** Harv. (*B. triphýlla,* Hort.). Erect-branched shrub, 8–10 ft., with gray hairs: lvs. in 3's, sessile, elliptic or oblong-lanceolate, 4–6 in. long: fls. in small axillary cymes, 1 in. across, satiny white, calceolaria-like, red-dotted inside, the upper lip flat, lower lip shorter and ventricose and 3-lobed. B.M. 8021. G.C. III. 36, Suppl. Dec. 10.—Hardy in the Isle of Wight.

BOX: *Buxus.*

BOX ELDER (*Acer Negundo,* which see). A very popular small native tree for planting on the prairies and in trying climates. It propagates most readily from seeds. It is an excellent nurse tree for other species. The wood is of inferior quality. It grows with great rapidity for a few years.



621. Brachycome iberidifolia.

BOYKÍNIA (named after Doctor Boykin, of Georgia). *Thérofon,* Raf. *Saxifragàceæ.* Glandular-pubescent perennial herbs, 7 species, of which one is Japanese and the others in the S. Alleghany region and Calif., two of which have been offered for wild gardens. Lvs. alternate, but mostly radical, stalked, blade orbicular or very broad and lobed or cleft: fls. white, small, in terminal clusters; petals 5, entire or nearly so; stamens 5; styles 2–3: fr. an urn-shaped or globose caps., erect or pendulous. Mostly mountain plants. **B. rotundifòlia,** Parry. Villous-pubescent, 2–3 ft., leafy: lvs. 2–4 in. across, orbicular or broadly ovate, crenately cut and toothed: fls. short-pedicelled, on one side of the branches; petals little surpassing the acute calyx-lobes. Water-courses, San Bernardino Mts. **B. aconitifòlia,** Nutt. Erect, 1–3 ft.: lvs. 2–6 in. across, nearly orbicular or reniform, palmately 5–7-lobed: fls. in a glandular-pubescent corymb; petals eroded; sepals triangular-ovate. Mt. slopes, Va. to Ga.—A pretty foliage plant for wild gardens and borders.

L. H. B.

BRACHYCHÆTA (Greek, *short bristle*). *Compósitæ.* A monotypic genus, growing in open woods from Ky. to N. C. and Ga. Closely allied to Solidago, from which it differs in the very short pappus (the bristles shorter than the achene), and the lower lvs. cordate. **B. cordàta,** Torr. & Gray (*B. sphaceloàta,* Brit.), which has been intro. by dealers in native plants, is 2–3 ft. high, soft-pubescent, with thin, serrate, ovate to orbicular-ovate lvs.: fls. golden yellow, in small heads, which are borne on the thyrsoid, secund branchlets; disk-fls. perfect.—Recommended for the native border, particularly in half shade.

BRACHYCHÌLUS (*short lip,* the labellum being suppressed). Spelled also *Brachychilum,* from the name as a subgenus of *Hedychium. Zingiberàceæ.* Herbaceous plants of two species, one or both of which have been cultivated abroad, in warmhouses. Closely allied to *Hedychium.* The species are *B. Hórsfieldii,* Peters (*Hedýchium Hórsfieldii,* Wall.), from Java; and *B. tenéllum,* Schum., from Moluccas. The former has been cultivated as *Alpinia calcarata.*

BRACHYCHÌTON (name referring to the short imbricated hairs and scales). *Sterculiàceæ.* Australian trees (about eleven species), grown to some extent in Florida and perhaps elsewhere South, often included with Sterculia, from which they differ (when the genera are distinguished) by bearing the radicle next the hilum in the seed, having the seeds and inside of carpels villous, and other technical characters.

Leaves entire or rarely lobed: fls. unisexual or polygamous, in panicles or racemes; calyx with 5 or 4 spreading lobes; petals wanting; stamens 10–15 in a column united with the pistils; ovary with 5 nearly or quite distinct carpels, the styles united under the peltate or lobed stigma.—Two showy-fld. species are reported in this country. **B. acerifòlium,** Muell. (*Stercùlia acerifòlia,* Cunn.). Large timber tree in its native country: lvs. long-stalked, 5- or 7-lobed, 8–10 in. across, the lobes oblong-lanceolate or almost rhomboid: fls. rich red, in loose racemes or small panicles; calyx ¾in. long, glabrous, broad-lobed; ovary borne on a short stalk or column: fr. large follicles, long-stalked, glabrous. **B. diversifòlium** may be either *B. diversifòlium,* R. Br.=*Sterculia caudata,* Heward; or *B. populnèum,* R. Br.,=*S. diversifolia,* Don, probably the latter and here described: tree, 20–60 ft., glabrous except the blossoms: lvs. long-stalked, ovate to ovate-lanceolate and entire, or more or less deeply 3- or 5-lobed: fls. yellowish white, reddish within, in axillary panicles that rarely exceed the lvs.; calyx broadly campanulate, about ¾in. diam., acutely lobed to middle: follicles nearly ovoid, sometimes 3 in. long, on stalks 1–2 in. long. Both species are reported as growing vigorously in high pine-land garden in Fla.; trunk unusually thick near the ground; characteristic in the open cone-like tops.

L. H. B.

BRACHYCÒME (*short hair,* from the Greek, alluding to the pappus). *Compósitæ.* About 40 species of Australian herbs, with membranaceous involucral

bracts, naked pitted receptacle, very short pappus bristles, and diffuse leafy growth, one of which is cult. as a garden annual; of very simple cult.

iberidifòlia, Benth. SWAN RIVER DAISY. Figs. 621, 622. A very graceful little annual (6–16 in. high), suited to borders, and also attractive in pots; seeds may be sown in the open or under glass: fls. blue, rose or white, an inch across: lvs. small, pinnate, with narrow divisions. H.F. 4:96. J.H. III. 54:461. V. 3:170. A good winter-bloomer 4 or 5 mos. after sowing. L. H. B.

622. Brachycome iberidifolia. (Natural size.)

BRACHYSÈMA (short standard, referring to the flower). *Leguminòsæ.* Shrubs or undershrubs, Australian, making good pillar or climbing plants for greenhouse; allied to Baptisia and Thermopsis.

Evergreen: lvs. opposite or alternate, simple, sometimes reduced to scales: fls. red or yellowish or almost black, solitary or several together or sometimes crowded on short radical scapes, the keel turned upward by the curving of the pedicels; stamens not united with each other: fr. ovoid or elongated, turgid.—About 14 species, a few of which are known in gardening literature. **B. acuminàtum,** Truff. (*B. speciòsum,* [illegible]), is now offered as a good red-fld. pillar plant: sub-frutescent: lvs. opposite, oval-elliptic, entire, more or less narrowed to base and short-petioled, the older ones long-acuminate: fls. deep carmine-red to nearly purple, in short axillary clusters, the corolla much exceeding the yellow-green calyx, the standard very small. R.H. 1866:413.—An attractive free-flowering species. L. H. B.

BRACHYSPÀTHA: *Amorphophallus variabilis, A. Titanum,* and others.

BRADLÈIA: *Phyllanthus* and *Wisteria.*

BRÀHEA (Tycho Brahe, the Danish astronomer). *Palmàceæ,* tribe *Coryphèæ.* Medium-sized, usually spineless palms except on the leaf-stalks, with ringed trunks, the upper part of which is usually clothed with the persistent leaf-bases.

Leaves usually numerous, nearly round and somewhat peltate, the many lfts. plicate and deeply 2-parted, sometimes slightly spiny on the margin, more often filamentous; petioles flattened, dentate or rarely spiny along the margins, very fibrous at the sheathing base: spathes usually linear, firm, almost woody, frequently perfectly glabrous; spadix much branched, sometimes twice or thrice paniculate and bearing among the dense white wool 1 or many sessile fls. in each cluster; fls. hermaphrodite, sometimes with inconspicuous bracts, 3 nearly round sepals, 3 valvate petals and 6 stamens: fr. small, ovoid, sometimes pubescent. Beccari admits only 4 species, all Mexican except *B. salvadorensis.* From its nearest horticultural relative, Sabal, Brahea is distinguished by the purely technical character of having 3 free carpels.

In a moderately warm house, the cultivated braheas will thrive very well. A mixture of sand, rich loam and well-rotted horse- or cow-manure is best. They require plenty of water. They are not very common in the trade but two species are grown outdoors in southern California. Propagation is by seeds, which are rare.

A. *Fls. solitary on the spadix.*

dúlcis, Mart. PALMA DULCE. Sts. several in a cluster, 10–20 ft., 6–8 in. thick, cylindrical: lvs. 4–5 ft. long; petiole plano-convex, green, with pale margins; ligule short, nearly triangular, green, the scarious villous margin at length deciduous; lfts. 36–50, linear, acuminate: spadix 6–8 ft., pendulous from among the lowest lvs., much branched: fr. edible. Mex. I.H. 10:379.

calcàrea, Liebm. (*B. nítida,* André). Trunk 8–15 ft. high, covered with the woody persistent lf.-bases: lvs. usually 20–30 in a dense bushy crown, unarmed, membranaceous, covered below with a brownish powder: spadix long, more or less erect and considerably longer than the lvs., after flowering more or less pendulous; fls. solitary, with a single bract: fr. ovoid. Mex. R.H. 1887, p. 344. Gn. 35, p. 285.—Offered by Montarioso Nursery.

AA. *Fls. in more or less dense, though small, clusters on the spadix.*

Pìmo, Becc. St. 8–12 ft.: much the same as the last in general appearance and vegetative characters: spadix 3–4-branched, the finer ramifications very slender and bearing small clusters of whitish yellow fls.; stamens 6, forming by unition a 6-lobed ring: fr. unknown.—A rare Mexican species, known in the trade only at Santa Barbara, Calif.

B. edùlis, Wendl., sometimes offered in Amer., is Erythea edulis, Wats.—*B. filamentòsa,* Hort.=Washingtonia filifera, Wendl.—*B. filifera,* Hort.=W. filifera.—*B. glaùca,* Hort.=Erythea armata, Wats.—*B. robùsta,* Hort.=Washingtonia.—*B. Roèzlii,* Lindl.=Erythea armata, Wats. N. TAYLOR.

BRÀINEA (C. J. Braine, Hongkong). *Polypodiàceæ.* One species related to Woodwardia. Lvs. in a crown, 1-pinnate, the venation as in Woodwardia, consisting of a single row of areoles along each midvein with free simple veins extending to the margins: sporangia along the free veins, not reaching the margin, without indusium.

insígnis, J. Smith. A beautiful small tree fern from S. E. Asia. Requires rich soil, moisture and shade. R. C. BENEDICT.

BRAKE. A name applied to various coarse ferns, particularly to *Pteris aquilina.*

BRAMBLE. Thorny plants of the genus Rubus,—raspberries, blackberries, dewberries.

BRASÈNIA (meaning unexplained). *Nymphæàceæ.* WATER-SHIELD or -TARGET. One species of aquatic plant widely distributed (in N. Amer., Asia, Afr., Austral.). Lvs. oval, entire, floating, centrally peltate; submerged parts coated with thick transparent jelly: fls. axillary near the summit of the st., small (½in.), purple; sepals 3 or 4; petals 3 or 4, linear; stamens 12–18, on filiform filaments; carpels 4–18, separate, forming indehiscent 1–2-seeded pods. **B. Schrèberi,** Gmel. (*B. peltàta,* Pursh. *B. purpùrea,* Casp.), is not a showy plant but is interesting and suitable for edgings of small aquatic gardens. Grows in 1–6 ft. of water. Easily prop. by division of roots or by seed. H. S. CONARD.

BRASSÁVOLA (A. M. Brassavola, Venetian botanist). *Orchidàceæ.* About twenty tropical American epiphytes, closely allied to Lælia, and demanding similar treatment.

The fls. are large, solitary or racemose, the sepals and petals narrow and greenish, the lip white: lvs. thick, solitary. For the cultivator, the treatment of Brassavola is identical with that of the Mexican lælias. Plenty of sun to mature the young growths, and water

when growing, with a somewhat drier atmosphere when resting, will be found to suit them. Suspend on blocks. *B. Digbyana*, Lindl., is *Lælia Digbyana; B. glauca*, Lindl., is *Lælia glauca.*

A. *Fls. solitary.*

B. *Lvs. long and narrow: lip fimbriate-toothed.*

cucullàta, R. Br. (*B. cuspidàta*, Hook.). Lf. terete and subulate, grooved above: scape very short but bearing a very long-tubed fl., so that the blossom seems to be elevated on a st.; sepals cream-colored, tinged red; petals white; lip 3-lobed, fimbriate, the middle lobe beak-like. S. Amer. B.M. 543, 3722. G.W. 11, p. 556. Gt. 1, p. 324. O.R. 10:265.

623. Brassavola cordata. (×⅕)

BB. *Lvs. short: lip entire.*

acaùlis, Lindl. & Paxt. Low: lvs. very narrow: fls. large, greenish white; lip cordate; tube red-spotted at base. Cent. Amer.

AA. *Fls. in racemes.*

B. *Blade of lip not longer than claw.*

cordàta, Lindl. Fig. 623. Lvs. linear, rigid, recurved: fls. corymbose; sepals and petals lance-linear, acuminate, pale green; lip roundish-cordate, cuspidate, entire, scarcely as long as the claw. Jamaica, Brazil. B.M. 3782.

BB. *Blade of lip longer than claw.*

C. *Claw ¾–1 in. long.*

nodòsa, Lindl. (*B. grandiflòra*, Lindl.). Lvs. lanceolate, acuminate, channeled above: fls. few and large, corymbose; sepals and petals linear-acuminate; lip round-ovate, long-cuspidate, entire, longer than the claw. Jamaica, Mex., S. B.M. 3229, of this name, is *B. subulifolia.*

CC. *Claw very short.*

fràgrans, Rod. Lvs. up to 16 in. long, terete, deeply furrowed above: raceme of 4–12 large fls.; sepals linear-lanceolate, yellowish white and faintly purple-spotted; petals linear, yellowish white; lip obovate, with a very short claw, a yellowish green spot at the base. Brazil. I.H. 5:180.

GEORGE V. NASH.†

BRÁSSIA (named in honor of William Brass, a botanical collector of the last century). *Orchidàceæ.* Epiphytic orchids, thriving in intermediate temperatures.

Pseudobulbs bearing 1 or 2 terminal lvs., and lateral or axillary racemes: sepals narrow, acuminate, or sometimes tailed, spreading, equal or the lateral longer; petals similar to the dorsal sepal or smaller; lip sessile on the foot of the column, spreading, flat, entire, shorter than the sepals; pollinia 2, waxy.—A genus of about 30 species extending from Mex. to Brazil and the W. Indies.

The brassias are plants of easy culture and add considerable interest to collections. They have little value as a florists' flower since the colors are not suitable, but a well-grown specimen, such as is often seen in old gardens, makes a most attractive object. The long-tailed sepals and petals are a characteristic of the brassias, and some have an agreeable odor. Pot culture is best, with the usual peat fiber as a rooting medium. In winter-time much less water is necessary than in the growing time, although the plants must never be dried off completely or the flowering will be interfered with. One often sees plants of *B. maculata* brought here by visitors to Jamaica, and other species are now introduced there from the mainland of South America, and thrive well. These may all be grown in an ordinary greenhouse with other plants, in fact a mixed collection, and give satisfaction. Propagation is effected by division only. Green-fly is often troublesome on the young flower-spikes and must be kept down by fumigation, or sponge dipped in soapy water. (Orpet.)

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A. *Lip with flat green warts.*

B. *Sepals 3–4 in. long: lip white.*

1. verrucòsa, Batem. Fig. 624. Pseudobulbs ovoid, much compressed, up to 4 in. long: lvs. up to 1 ft. long: racemes 8–15-fld.; sepals and petals light yellowish green, spotted at base, the sepals 3–4 in. long, the petals about half as long; lip white, with numerous dark green warts, with a broad dilated claw, the upper part nearly orbicular, abruptly acuminate. Guatemala.

BB. *Sepals 6 in. long: lip light yellow.*

2. brachiàta, Lindl. Pseudobulbs 3–5 in. long, oblong, compressed: lvs. up to 1 ft. long: racemes 6–12-fld.; sepals and petals light yellowish green, with a few purple basal spots, the petals about two-thirds as long

624. Brassia verrucosa. (×⅜)

as sepals; lip light yellow, with dark green warts, constricted at the middle, the basal part nearly orbicular, the upper portions broadly triangular-ovate, acuminate. Guatemala. B.R. 33:29.

AA. *Lip without warts.*

B. *The lip with a broad claw, broadly obovate or nearly orbicular above.*

C. *Lateral sepals lanceolate, about 3 in. long.*

3. **maculàta,** R. Br. Pseudobulbs 3–4 in. long, 1-lvd.: lvs. up to 9 in. long: racemes of 5–10 fls.; sepals and petals yellowish green, brown-spotted on the lower part, the sepals about 3 in. long, the petals two-thirds as long; lip cream-white, purple-dotted, with broad claw, the upper part broadly ovate, acute. Jamaica. B.M. 1691. P.M. 6:5. Var. **guttàta,** Lindl. (*B. Wràyæ,* Skinner). Fls. smaller and greener. Guatemala. B.M. 4003.

CC. *Lateral sepals narrowly linear, 4–5 in. long.*

4. **Gireoudeàna,** Reichb. Pseudobulbs 1-lvd., 3–4 in. long and about half as broad, much compressed: lvs. up to 1 ft. long: racemes with 6–12 fls.; sepals yellowish green, the base brown-spotted, the lateral sepals up to 5 in. long, the dorsal a little shorter; petals about half as long as dorsal sepal, the base brown, the remainder yellowish green; lip yellow, brown-spotted, with a broad claw, the upper part nearly orbicular, acute. Costa Rica.

BB. *The lip not clawed.*

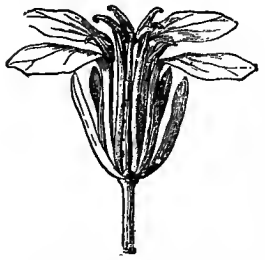
C. *Lateral sepals 6–8 in. long.*

D. *Sepals greenish yellow; lip ovate.*

5. **caudàta,** Lindl. Pseudobulbs up to 5 in. long: lvs. up to 10 in. long: racemes with 6–12 fls.; sepals and petals greenish yellow, brown-spotted at base; dorsal sepal about 3 in. long, the lateral 6 in.; petals about 1 in. long; lip without a claw, ovate, acuminate, light yellow with brown spots. W. Indies. B.R. 832. B.M. 3451. A.F. 6:609.

DD. *Sepals deep orange-yellow; lip oblong-lanceolate.*

6. **longíssima,** Nash (*B. Lawrenceàna,* Lindl., var. *longíssima,* Reichb.). Pseudobulbs 2–3 in. long, compressed, 1-lvd.: lvs. up to 9 in. long: racemes of numerous fls.; sepals and petals deep orange-yellow, with a few large basal blotches; the dorsal sepal about half as long as the lateral which are 7–8 in. long and about ¼in. wide at base; the petals 2–3 in. long; lip oblong-lanceolate, about 3 in. long, pale yellow, acuminate, purple-spotted at base. Costa Rica. B.M. 5748.



625. Flower of mustard. (×2)

CC. *Lateral sepals 2½–3 in. long.*

D. *Crest 2-lobed; lip oblong.*

7. **Lanceàna,** Lindl. Pseudobulbs 2-lvd., 3–5 in. long, much compressed and ribbed: lvs. up to 1 ft. long: racemes of 7–12 fls.; sepals and petals light yellow, brown-spotted below, the sepals 2½–3 in. long, the petals about half as long; lip oblong, yellow, unspotted or with a few basal brown spots, undulate, acute, 1–1¼ in. long. Guiana. B.R. 1754. B.M. 3577.

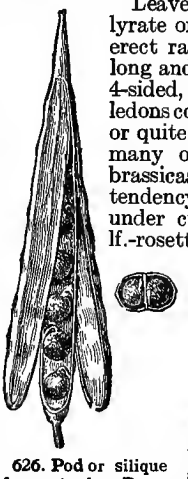
DD. *Crest truncate in front; lip oblong-lanceolate.*

8. **Lawrenceàna,** Lindl. Pseudobulbs 2-lvd., 3–5 in. long, ribbed and much compressed: lvs. up to 1 ft. long: racemes of 7–12 fls.; sepals and petals light yellow, brown-spotted below, the sepals about 3 in. long, the petals about 1½ in. long; lip oblong-lanceolate, light yellow, about 1½ in. long, acute, undulate. Brazil. B.R. 27:18. J.H. III. 30:275.

B. Forgetiàna, Hort. Fls. whitish with chocolate markings, the crest of the lip orange. Related to B. maculata. G.C. III. 48:471. —*B. Josstiàna,* Reichb. f. Brazil. Gt. 3:308.

GEORGE V. NASH.

BRÁSSICA (old classical name). Including *Sinàpis.* *Cruciferæ.* Annual and biennial herbs, including cabbage and turnip, and their allies, and also the mustards. Leaves various, the lower ones mostly lyrate or pinnatifid: fls. yellow, mostly in erect racemes; petals and stamens 4: pod long and slender, compressed-cylindrical or 4-sided, beaked; seeds not winged, the cotyledons conduplicate (Figs. 625, 626).—Nearly or quite 100 species in Eu., Asia, Afr., and many of them widely naturalized. The brassicas possess a remarkable natural tendency toward the thickening of parts under cult., as of root, st., axillary buds, lf.-rosettes, midribs and even of fl.-clusters. Oil is extracted from the seeds of several species, and the ground mustard of commerce is made from the seeds of *B. nigra* and others.



626. Pod or silique of mustard.—Brassica juncea. (×1½)

The brassicas are botanically much confused, particularly in the groups containing cultivated species. The manuals probably contain too few rather than too many species of Brassica; at least, the miscellaneous throwing of rutabagas, turnips, rape and other plants into *Brassica campestris* is unnatural, and, therefore, unfortunate. One of the best presentations of the true brassicas is that of De Candolle's Prodromus, as long ago as 1824 (also in Trans. Lond. Hort. Soc., Vol. V, and in Systema, 2:582–607), and the present treatment follows that outline in general. Some of the forms that are here kept separate as species may be derived from their fellows, but the evidence of such origin is lost, and perspicuity demands that they be kept distinct in a horticultural treatise. The taxonomic arrangement here presented can be regarded as only tentative, however, and new systematic studies should be made of the entire group.

The confusion into which our brassicas have fallen is in some measure due to the various vernacular names in the different countries. The French use the word chou generically to include all forms of *B. oleracea* and the rutabaga—that is, all the blue thick-leaved brassicas; while in England the rutabaga is called the Swedish turnip. A tabular view of the different vernaculars may be useful:

French.	*English.*	*American.*
Chou cabus	Cabbage	Cabbage
Chou de Milan	Savoy cabbage	Savoy cabbage
Chou de Bruxelles	Brussels Sprouts	Brussels sprouts
Choux-verts	Borecole or Kale	Borecole or Kale
Chou-rave	Kohlrabi	Kohlrabi
Chou-nave	Swede, or Swedish turnip / Turnip-rooted cabbage	Rutabaga
Chou-fleur	Cauliflower	Cauliflower
Navet	Turnip	Turnip

The Latin names in Brassica, particularly in the oleracea-campestris group, have been so variously used that it is practically impossible to place some of them accurately.

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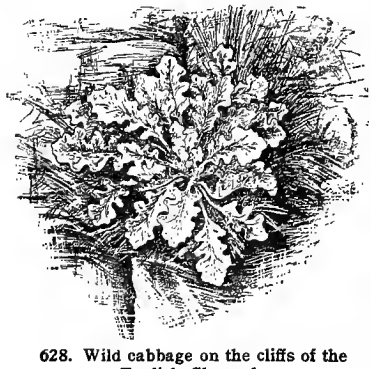
A. *Whole plant glaucous-blue when in fl.: lvs. of the fl.-sts. clasping: fls. various.* (*Mostly Brassica proper.*)

B. *Lvs. from the first more or less fleshy throughout, and glaucous-blue even when young: fls. large and creamy yellow, the petals conspicuously long-clawed, and the sepals usually erect.*

1. **oleràcea**, Linn. CABBAGE, CAULIFLOWER, BRUSSELS SPROUTS, KALE. Fig. 627. Lvs. smooth from the first, and the root not tuberous: fls. large and long (¾–1 in. length, at least often), light-colored, slender-pedicelled, in long and open racemes: pods large, long-beaked. If the name *Brassica oleracea* is held for a generalized group without a type form, then the wild plant may be designated as var. *sylvéstris*, Linn. In the present treatment, however, the wild form is regarded as the type and is therefore not given a varietal name. *Brassica oleracea* grows wild on the sea-cliffs of W. and S. Eu. Fig. 628, from nature, shows the common form as it grows on the chalk cliffs of the English Channel. It is a perennial plant of short duration, or perhaps sometimes a biennial, with a very tough and woody root, a diffuse habit, and large thick deep-lobed lvs. in various shades of green and reddish, and more or less glaucous. The lvs. of this plant were probably eaten by the barbarous or half-civilized peoples; and, when history begins, the plant had been transferred to cult. grounds and had begun to produce dense rosettes or heads of lvs. It appears to have been in general use before the Aryan migrations to the westward. There were several distinct types or races of the cabbage in cult. in Pliny's time. From the one original stock have apparently sprung all the forms of cabbages, cauliflowers, brussels sprouts and kales. For this family or group of plants the English language has no generic name. The French include them all under the term *Chou*, and the Germans treat them under *Kohl*. These various tribes may be classified as follows:

627. Flowers of cabbage.—Brassica oleracea. (×½)

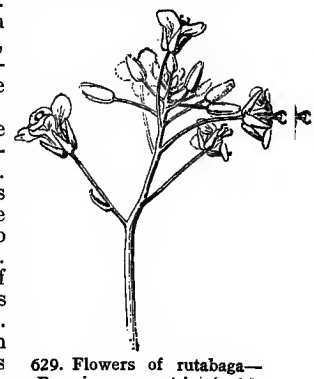
Var. **acéphala**, DC. Fig. 706. The various headless cabbages, comprising kales or borecoles, in many types and varieties, as the tall or tree kales, curled or Scotch kales, and collards. Its likeness may be found wild on the cliffs of the southeastern coast of England today. The thick, tender lvs. of the kales are used as "greens." See *Collards* and *Kale*. It is not certain that all the kales and collards belong here; some of them may be *B. campestris*.



628. Wild cabbage on the cliffs of the English Channel.

Var. **Caùlo-Ràpa**, DC. KOHLRABI (which see). St. tuberous above the roots, the tuber bearing the lvs.

Var. **gemmífera**, DC. The bud-bearing cabbage, or brussels sprouts (see Fig. 672). In this group, the main st. or axis is tall and erect, and axillary buds are developed into little heads. See *Brussels sprouts*.



629. Flowers of rutabaga—Brassica campestris. (×½)

Var. **capitàta**, Linn. The head-bearing, or true cabbages, kraut of the Germans. In this group, the main axis is short and thick, and the lvs. are densely packed into a gigantic bud or head (Figs. 701–705). The varieties of cabbage are very numerous and various. See *Cabbage*. A serviceable classification of them might follow this order:

A. Lvs. plain (not blistered).
  B. Head oblong or conical (Fig. 701).
    C. Green.
    CC. Red.
  BB. Head oblate or flattened (Fig. 702), including C and CC, as above.
AA. Lvs. blistered or puckered. The Savoy cabbages, Fig. 703 (*B. oleràcea* var. *bullàta*, DC., or var. *sabaùda*, Linn.), to be further divided, as in A.

Var. **botrỳtis**, Linn. Cauliflower and broccoli, in which the head is formed of the condensed and thickened fl.-cluster. Broccoli produces its heads later in the season than cauliflower, and in mild climates it is allowed to remain and make its heads in spring. See *Cauliflower*.

2. **Nàpus**, Linn. RAPE. Lvs. smooth from the first: differs from *B. oleracea* chiefly in habit and more deeply scalloped lvs. There are oil-producing forms (var. *oleifera*, DC.). The botanical position of the rapes is doubtful.

3. **campéstris**, Linn. First lvs. hairy; all lvs. glaucous and thickish or somewhat fleshy, the lower ones lyrate and toothed, the st.-lvs. cordate-amplexicaul and acuminate: fls. shorter and also smaller than in the *B. oleracea* series (Fig. 629). A weed in waste places, in its run-wild form, but rarely persisting long or becoming troublesome. There are oil-bearing forms (var. *oleifera*, DC.).

630. Pak-choi.—Brassica chinensis.

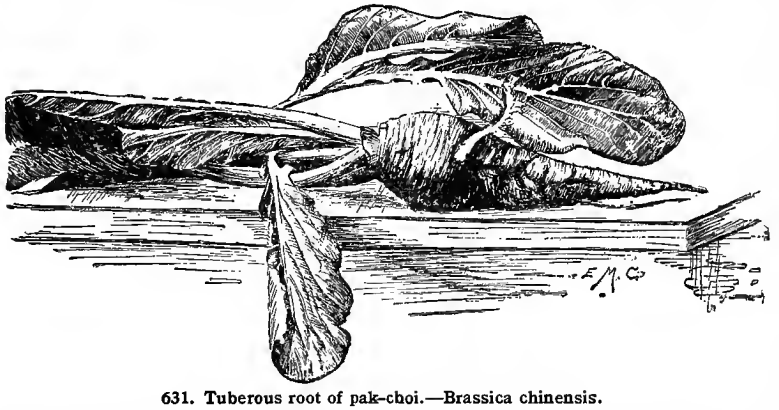
Var. **Nàpo-Brássica**, DC. (*B. oleràcea* var. *Nàpo-Brássica*, Linn.), is the rutabaga evolution of the plant. The rutabaga tuber is either white-fleshed or yellow-fleshed, but the preference in this country seems to be for the yellow kinds. For contrasts with turnips, see No. 4; also *Turnip* in Vol. VI.

BB. *Lvs. (except upon the fl.-st.) thin and green: fls. smaller and bright yellow, less prominently clawed.*

C. *Plant potentially biennial (that is, the root hard and thickened, often distinctly tuberous): foliage firm in texture.*

D. *Foliage distinctly hairy.*

4. Rāpa, Linn. COMMON TURNIP. Lvs. prominently lyrate or interrupted below, the root tuberous.—Whatever the origin of the rutabaga and turnip may be, the two plants show good botanical characters. The tubers of the two are different in season, texture and flavor. In the rutabaga, the small lvs. immediately following the seed-lvs. are sparsely hairy, but all subsequent lvs. are entirely smooth, densely glaucous blue, thick and cabbage-like, with a fleshy petiole and midrib. In the turnip, the radical lvs. are always more or less hairy, and they are green and radish-like, thin, with slender petiole, and the lvs. are much more lyrate, with interrupted lfts. on the petiole; the small lvs. following the seed-lvs. are also thinner and narrower and more deeply scalloped. In the rutabaga, the fls. are large and creamy-yellow, whereas in the turnip they are small, yellow and mustard-like, with shorter claws and more spreading calyx. The turnips vary in hairiness, but the cone of expanding lvs., or the "heart-lvs.," always shows the hairs distinctly, while the heart-lvs. of the rutabagas are normally entirely glabrous, fleshy, and remind one of the young shoots of sea-kale. The turnip usually produces seed freely if the bottoms are left in the ground over winter; and thereby the plant spreads, becoming a true annual and a bad weed, with a slender hard root. Oil-producing forms are var. *oleifera,* DC.

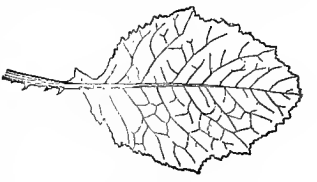


631. Tuberous root of pak-choi.—Brassica chinensis.

DD. *Foliage not hairy.*

5. chinénsis, Linn. PAK-CHOI CABBAGE. Fig. 630. Radical lvs. broad and ample, glossy green, obovate or round-obovate in general outline, either entire or obscurely wavy or even crenate, tapering to a distinct and thick strong petiole, which is usually not prominently margined: pod large and tapering into a beak half an inch long: root sometimes tuberous (Fig. 631).—This plant is grown by the American Chinese, and is occasionally seen in other gardens (see Bailey, Bull. No. 67, Cornell Exp. Sta.). It is impossible to determine whether this particular plant is the one that Linnæus meant to distinguish by his *Brassica chinensis,* but it best answers the description in his Amœnitates (Vol. IV). In Linnæus' herbarium is a Brassica marked "chinensis" in his own handwriting, but it shows purple fls. and has lyrate-lobed lvs., whereas Linnæus described his plant as having yellow fls. and cynoglossum-like lvs.; probably not the original.

6. napifórmis, Bailey (*Sinàpis júncea* var. *napifórmis,* Paill. & Bois). TUBEROUS-ROOTED CHINESE MUSTARD. Fig. 632. Radical lvs. comparatively few, the blade thin and oval in outline, and on long and slender, slightly feathered petioles, sharply and irregularly toothed, with a thin bloom: beak of the pod more abrupt: root distinctly hard and tuberous. China.—This vegetable appeared in France in 1882 from seeds sent by Bretschneider, of the Russian legation, Pekin. It was offered by American seedsmen as early as 1889. The plant is a biennial, with thin bluish foliage, and a small tuberous root like a conical turnip. These roots reach a diam. of 3 or 4 in., and are scarcely distinguishable from white turnips in appearance, texture and flavor. In China the tubers are used as a winter vegetable, the seeds being sown in summer. The plant does not appear to have been brought to the attention of botanists until Bretschneider published an account of it in a French journal in 1881. Paillieux and Bois (Le Potager d'un Curieux) regard it as a variety of *Brassica juncea,* to which the Chinese mustard belongs, but it is very different from that plant. It is nearly related to pak-choi, and it may have sprung from the same species; but it is clearly distinguished by its sharply toothed lvs., one of which is shown in Fig. 632.



632. Lower stem leaf of Brassica napiformis.

CC. *Plant truly annual: foliage profuse, loose and soft.*

7. Pe-tsâi, Bailey. PE-TSAI CABBAGE. Fig. 633. Numerous radical lvs., large and light green, oblong or ovate-oblong, crinkled and very veiny, and the margins wavy, contracted into a flat and ribbed petiole 1–3 in. wide, which is provided with a wide thin notched or wavy wing; st.-lvs. sessile and clasping: pod of medium size, with a short cone-like beak.—The pe-tsai, or Chinese cabbage, is no longer a novelty in American gardens, although it does not appear to be well known, and its merits are not understood. Its cult. and peculiarities were described in France as long ago as 1840, by Pepin, who says that, while the plant had been known in botanic gardens for 20 years, it was brought to notice as a culinary vegetable only 3 years before he wrote. It appears to have attracted little attention in Eu. until late in the last century, however. It began to attract attention in the U. S. probably about 25 years

633. Brassica Pe-tsai.

ago. The lvs. tend to form an oblong loose head, like cos lettuce. *Cabbage;* also page 3582.

AA. *Whole plant green or but slightly glaucous when in fl.: lvs. on the fl.-sts. not prominently clasping: fls. small and yellow. Annuals.* (*Sinapis or Mustard.*)

B. *Pod long, terete or nearly so: pedicels spreading.*

8. **japónica,** Sieb. POT-HERB MUSTARD. Fig. 634. Annual, self-sowing: rather numerous radical lvs., oblong or oblong-obovate, the margins either crisped or cut into many very fine divisions, the petiole distinct at its lower end; st.-lvs. all petioled: pod very small, with a slender beak. —The very soft thin lvs. make excellent "greens." Long known, but with no designative name, in old gardens in this country, and sometimes run wild about premises. Intro. in 1890 by John Lewis Childs as California pepper-grass. A very worthy plant (Bull. 67, Cornell Exp. Sta.).

634. Brassica japonica, the radical leaves used for greens.

9. **júncea,** Coss. (*Sinàpis júncea,* Linn.). CHINESE MUSTARD. Figs. 626, 635. Rank and coarse grower, in the common forms making great tufts of root-lvs. if sown early: radical lvs. usually abundant and often very large, oval or obovate in outline, the blade angled or toothed, tapering into a narrow petiole, which generally bears leafy appendages; lower st.-lvs. more or less toothed and petiolate, the upper ones oblong or oblong-lanceolate, entire and usually sessile or alternate: flowering sts. and lvs. more or less lightly glaucous: fls. bright yellow: pod slender, of medium size, tapering into a short seedless beak. Asia.—This species is held by Hooker and Thomson (Journ. Linn. Soc. v. 170) to include a great variety of forms, as *Sinapis lævigata,* Linn.; *S. integrifolia,* Willd.; *S. ramosa, S. rugosa, S. patens, S. cuneifolia,* Roxbg.; *S. lanceolata,* DC., and others. There are two types of it in cult. in our gardens, one with the radical lvs. somewhat sharply toothed and nearly smooth below (sometimes grown as *Brassica* [or *Sinapis*] *rugosa*), the other with root-lvs. obtusely toothed and spinescent on the veins below (comprising Chinese mustard, Chinese broad-leaved mustard, and brown mustard). Linnæus founded his *Sinapis juncea* on a figure in Hermann's Paradisus (Hermann, Paradisus Batavus, t. 230, 1705), which represents a plant very like the former type mentioned above, and which Hermann described as "lettuce-leaved."

635. Broad-leaved Chinese mustard.—Form of Brassica juncea.

10. **álba,** Boiss. WILD MUSTARD. Tall: lvs. pinnatifid and rough-hairy: pods spreading, hairy, the lower part thick and few-seeded, the beak longer: seeds pale brown, large. Weed, from Eu.

11. **arvensis,** Kuntze (*B. Sinapistrum,* Boiss. *Sinàpis arvénsis,* Linn. *Sinapistrum arvénse,* Spach). CHARLOCK. Tall: lvs. strong-toothed, or sometimes nearly lyrate: pods knotty, glabrous or hairy, the upper third indehiscent and 2-edged, usually 1-seeded. Weed, from Eu.

BB. *Pod short, distinctly 4-angled: pedicels and pods appressed.*

12. **nìgra,** Koch. BLACK MUSTARD. Fig. 636. St. tall and upright, with wide-spreading branches: lvs. pinnatifid, somewhat hairy: pods short and erect, glabrous; seeds small and dark brown, pungent, supplying the mustard of commerce. Cult. in Eu., but a weed in this country.—Commercial mustard is the flour of the seeds of this species chiefly, but the seeds of *B. alba* and probably of *B. juncea* are sometimes used.

B. adprέssa, Boiss. Annual or biennial, much like *B. nigra* but st. stiffer, lvs. less divided and plant somewhat hoary: pods with a short 1-seeded beak. Occasionally adventive from Eu.—*B. sinénsis,* Hort.= B. chinensis.

Many forms of Brassica have been described that it is not necessary to endeavor to account for here. Studies in crossing may be expected to indicate some of the relationships. The writer has found no difficulty in crossing cabbage-kale-cauliflower and others. See Lund and Kjaerskou, Landbrügets. Kulturplanter No. 4; and "Morfologisk-anatomisk beskrivelse af Brassica oleracea, B. campestris og B. Napus.'

L. H. B.

BRASSOCATTLÆLIA (compounded from *Brassavola, Cattleya* and *Lælia*). *Orchidàceæ.* A small group of trigeneric hybrids between the genera Brassavola, Cattleya and Lælia.

B. balarucénsis (B. Digbyana × L.-C. Schilleriana).—*B. Fuersténbergii* (Brassolælia Gratrixiæ × C. Trianæ).—*B. Máckayi* (B. Digbyana × L.-C. elegans). See also *Adamara* and *Linneara.*

636. Siliques of Brassica nigra. (×1)

BRÁSSOCÁTTLEYA (compounded from *Brassavola* and *Cattleya*). *Orchidàceæ.* A genus established to include hybrids between the species of the genera Brassavola and Cattleya.

The following, among others, are offered in the American trade:

B. Akèbenii (B. Digbyano-gigas × C. Luddemanneana).—*B. Alexánderi* (B. Digbyana × C. citrina).—*B. Chámberlainiæ* (B. Digbyana × C. quadricolor).—*B. Clíftonii,* Hort. (B.-C. Digbyana-Massiæ × C. Trianæ var. Uplands). G.C. III. 45:34. O.R. 18:48.—var. *Wéllesleyæ,* Hort. G.C. III. 51:135.—*B. conspícua* (B. glauca × C. Leopoldii).—*B. Digbyàno-Fórbesii* (B. Digbyano × C. Forbesii).—*B. Digbyàno-gìgas* (B. Digbyana × C. Gigas).—*B. Eva* (C. Lawrenciana × B. Digbyana).—*B. gesneriæflòra* (B. fragrans × C. maxima).—*B. heatonénsis* (B. Digbyana × C. Hardyana).—*B. Hólfordii* (C. Forbesii × B. Digbyana).—*B. Hỳeæ* (B.

Digbyana × C. Harrisoniana).—*B. langleyénsis* (B. Digbyana × C. Schroederæ).—*B. Laurentiàno-glaùca* (B. Laurentiano × C. glauca).—*B. Leemánniæ* (B. Digbyana × C. Dowiana). O.R. 11:57.—*B. Marìæ* (B. Digbyana × C. Warneri).—*B. Marònæ* (B. Digbyana × C. Warscewiczii).—*B. nivàlis* (B. fragrans × C. intermedia).—*B. Peètersii* (B. glauca × C. Lawrenceana).—*B. Pocahóntas* (B. Digbyana × C. Eldorado).—*B. Sánderi* (B. glauca × C. Schroederæ).—*B. sandhaghénsis* (B. Digbyana × C. Setulleriana).—*B. striàta* (B. fragrans × C. Mossiæ). Fls. rose-colored, fragrant. R.H. 1903:276, desc.—*B. Sùsannæ*. (B. Digbyana × C. Thayeriana).—*B. Thórntonii* (B. Digbyana × C. Gaskelliana). J.H. III. 61:601.—*B. Vèitchii* (B. Digbyana × C. Mossiæ).—*B. Vilmoriniàna* (B. Leemanniæ × C. Mossiæ).—*B. Wéllesleyæ* (B. glauca × C. Mossiæ Wageneri).

Brassavola Digbyana, Lindl., is now considered a Lælia, so the above hybrids, under that conception, might be designated Lælio-Cattleya.

GEORGE V. NASH.

BRÁSSO-LÆLIA (compounded of the genera *Brassavola* and *Lælia*). *Orchidàceæ*. Established to include hybrids between the two genera.

The following are to be found in the American trade: *B. Canàri* (B. Digbyana × L. xanthina).—*B. Digbyàno-purpuràta* (B. Digbyana × L. purpurata).—*B. fladòsa* (B. nodosa × L. flava).—*B. Helen* (B. Digbyana × L. tenebrosa). O.R. 10:169.—*B. Jéssopii* (B. Digbyana × L.-C. xanthina).—*B. Lellieúxii* (B. Digbyana × L. anceps).—*B. Rólfei* (B. Digbyana × L. crispa).—*B. Thwàitesii* (B. Digbyana × L. grandiflora).—*B. Vèitchii* (B. Digbyana × L. purpurata).—*B. westfieldiénsis* (B. glauca × L. flava).

Brassavola Digbyana, Lindl., is now considered a Lælia, so the above hybrids, under that disposition, might be designated as hybrid Lælias.

GEORGE V. NASH.

BRÁSSO-LÆLIA-CÁTTLEYA. *Orchidàceæ*. A trigeneric hybrid. *B.-L.-C. Fòwleri* (C. Schroederæ aurantiaca × Brasso-Lælia Mrs. M. Gratrix). Fls. yellow, tinged, and veined with salmon-rose. G.C. III. 41: 303. *Brassavola Digbyana*, one of the elements, is now considered a Lælia, and the plant would then belong to Lælio-Cattleya.

GEORGE V. NASH.

BRAVÒA (Bravo, Mexican botanist). *Amaryllidàceæ*. A small genus, much resembling in some of its species the tuberose (Polianthes), and hardly distinct from it.

Stems slender, from small thickened rootstocks: lvs. mostly basal: infl. a lax spike or raceme; fls. always in pairs, more or less bent or curved; stamens 6, included within the perianth-tube: fr. 3-celled, many-seeded. Native of the mountain and tableland region of Mex.—Five species have been described formerly, but recent explorations have discovered some 5 or 6 additional species.

While the flowers are not so showy as the common tuberose, yet the genus should be found in every choice bulb collection. Only one species has been cultivated to any extent, and even this species is not well known. As the species often grow in the high mountains of Mexico, they ought to be hardy in the southern stretches of the temperate zone.

geminiflòra, Llav. & Lex. MEXICAN TWIN-FLOWER. Sts. 1–2 ft. high: bulbs small, 1–1½ in. long, the outer scales cut into fine fibers at the top: basal lvs. linear, erect, 6 lines or less broad, smooth: fls. in a slender raceme, reddish or orange-colored; lobes minute, rounded. B.M. 4741.—Handsome, and worthy of more attention.

B. Bullidna, Baker. Basal lvs. described as lanceolate, 1–1½ in. broad: fls. in 5 or 6 paire, white. Seemingly too near the little-known Polianthes mexicana. Not in cult.—*B. sessiliflòra*, *B. densiflòra*, and *B. singuliflòra*, are rare species, only known from herbarium specimens. The latter two, however, should probably be excluded from this group.

J. N. ROSE.

BRÀYA (Count de Bray, 1765–1831, German botanist). *Crucíferæ*. Small tufted alpine or boreal perennial herbs, sometimes grown in alpine gardening. There are a dozen or more species in Eu., Asia and Amer. Plant glabrous or cano-tomentose: lvs. radical, spatulate or linear, entire or dentate: fls. on scapes that often are naked and sometimes only 1-fld. but mostly bearing racemes or corymbs, white or rose-colored or purple. *B. alpìna*, Sternb. & Hoppe, is the usual species, with white fls. *B. pinnatífida*, Koch (probably properly *Sisýmbrium pinnatífidum*, DC.), has white-lilac fls. Practically unknown in cult. in N. Amer.

BRAZIL-NUT: *Bertholletia*.

BREAD-FRUIT: *Artocarpus*.

BREAD-NUT: *Brosimum Alicastrum*.

BREEDING OF PLANTS. The definite producing of kinds of plants adapted to given uses and conditions is known now as plant-breeding. The existing varieties are of course the result of the action of natural tendencies and laws, but the producing of them has not been, for the most part, a conscious, or at least not a regulated, act on the part of man. The laws of variation and inheritance are now beginning to be understood, and the application of this knowledge is to produce orderly and more or less predictable results.

In beginning the artificial cultivation of plants, our early ancestors, even with their crude understanding and methods, probably selected seed for planting from the best wild individuals of any plant. The selection of seed from the best individuals has thus been continuing for thousands of years, ever since the dawn of civilization. While this is a crude method of breeding, if long continued on an extensive scale, it could not, as is now recognized, fail to have results. The greatness of the changes produced is shown by the fact that some of the most extensively cultivated crops, such as wheat and maize, have been so modified that the wild types from which they sprang cannot now be recognized, although the original wild ancestors probably still exist.

Breeding did not become established as an art until comparatively recently. The sexuality of plants was not established until it was proved experimentally by Camerarius in 1691; and the first hybrid of which there is record was made in 1719 by Thomas Fairchild, an English gardener, who crossed the carnation with the sweet william. The first exact knowledge of hybridization dates from about 1761 when Koelreuter began publishing the results of his observations, but even his work had little bearing on practical plant-breeding. The systematic breeding of plants may be said to have begun with the work of Knight and Von Mons about the beginning of the nineteenth century.

Knight worked mainly in hybridization and in 1806 said: "New varieties of every species of fruit will generally be better produced by introducing the farina of one variety of pollen into the blossoms of another than by propagating from a single bud." Von Mons worked mainly in selection and it is interesting to note that his experiments were made primarily with pears. He emphasized continuous selection and produced very many valuable varieties. It is probable that a large part of the success of Von Mons' work was due to the fact that pears are normally sterile to their own pollen, requiring cross-fertilization, and, therefore, many of his new varieties were probably hybrids. He was not aware of this fact, however, and it made no great difference in the establishment of the principle which has since proved to be so important.

A most important stimulus to the development of

plant-breeding was given by the publication of Darwin's famous works, particularly his "Animals and Plants under Domestication," in 1868. His extensive researches, masterful compilation and systematization of the existing knowledge may be said to have established breeding on a systematic basis.

Following Darwin, little advance was made in the knowledge of the principles of breeding until in 1900, when Mendel's papers on plant hybridization, describing his now famous principles or laws of inheritance, were rediscovered independently and brought to attention by DeVries, Correns and Tschermak. The discovery of these laws and the publication of DeVries' "Mutation Theory" in the same year, marked the beginning of a new era in plant-breeding. No matter what the final conclusions may be regarding Mendel's principles and the mutation theory, the stimulation which these two theories have given to breeding has already served greatly to modify and extend knowledge, both in scientific and practical directions.

637. Variations in size of wheat plants grown side by side in field.

The great advance that has been made in the discovery of the underlying principles of breeding puts experimentation in this field on a much surer basis and the breeder can now approach his subject with definite understanding.

Classification of varieties.

To understand clearly the character of organisms with which breeding deals, careful definitions of the different groups of cultivated plants which are ordinarily known as varieties are needed. One speaks of varieties of wheat, corn, apples and pears, yet it is known that these varieties differ from each other as natural groups. In order to distinguish clearly these differences, the following classification of varieties into races, strains and clons has been proposed:

Races are groups of cultivated plants that have well-marked differentiating characters, and propagate true to seed except for simple fluctuating variations. The different groups of beans, peas, wheat, oats, corn, cotton, and the like, referred to commonly as varieties, are thus in a more restricted sense races. Boone County White, Leaming, Golden Bantam, and so on, would be recognized as races of corn, and Turkey Red, Fulcaster, Fultz, as races of wheat, and Early Paris, Dwarf Erfurt and Snowball as races of cauliflower.

Strains are groups of cultivated plants derived from a race, which do not differ from the original of the race in visible taxonomic characters. When the breeder, by a careful selection of Blue Stem wheat, produces a sort of Blue Stem that differs from the original race only in the quality of yielding heavily, it would be called a strain of Blue Stem.

Clons are groups of cultivated plants the different individuals of which are simply transplanted parts of the same individual, the reproduction being by the use of vegetative parts such as bulbs, tubers, buds, grafts, cuttings, runners, and the like. The various sorts of apples, potatoes, strawberries, chrysanthemums, and so on, commonly denominated varieties, in a more restricted sense would be clons. Clons of apples, pears, strawberries, potatoes, and the like, do not propagate true to seed, while this is one of the most important characters of races and strains of wheat, corn, and others. The term variety would thus be used in a general sense, and would include races, strains and clons.

Heredity.

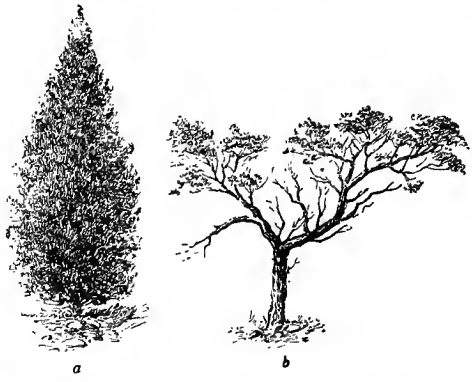
The laws of heredity are of primary importance to the breeder. It is a general principle that like begets like, but it is also true that like frequently gives rise to unlike. In general, by heredity is meant the tendency which an organism manifests to develop in the form and likeness of its progenitors, and the study of heredity includes thus the inheritance of characters. It is of the utmost importance that organisms in general reproduce their kind, as otherwise the breeder would be confronted with confusion, but it is of equal importance that the offspring does not always reproduce the parental characters. There are thus apparently two conflicting principles in plant-breeding. On the one hand, the breeder seeks to produce variations in order to get new types as the foundations for improvement. On the other hand, when such a variation from or improvement on the normal type is secured, he reverses the process and tries to establish heredity and reduce the amount of variation, so that the aphorism, "like begets like," will hold true.

In pedigree- or grade-breeding, and in breeding to produce new varieties, the importance of hereditary strength cannot be overestimated, as it is only by rendering this power very great that any new form can be brought to what is called a fixed type.

In recent years, the ideas of fixity of type have been greatly modified, and it is now held that fixity of type is secured by purifying a race from all admixtures so that any character represented in a race will be pure.

Unit-characters.

The modern studies of heredity have led to a new conception of organic characters that should be clearly understood by the breeder. A careful study of species or varieties of plants or animals focuses the attention not on the generality of the differences existing but rather on the differences in certain characters; one observes whether a plant is smooth or hairy, cut-leaved or entire-leaved, much branched or simply branched, erect or procumbent, tall or short, and the like. This leads to the conception that a plant is not of simple organization but is comprised of a combination of characters. These characters or the physiological units which cause them are now thought of as in considerable measure independent of each other and as representing distinct organic units. The classical studies of Gregor



638. Red cedar: *a*, Columnar form; *b*, Spreading form.

Mendel on the hybridization of races of peas that exhibited different characters established the fact that at least certain characters are inherited separately and may form permanent new combinations.

A unit-character, then, may be defined as any characteristic quality or set of qualities or expression of character in an organism that is inherited as a whole and independent of any other quality or set of qualities. They are the organic units of inheritance. The units that are considered in hybridization are not the species or varieties themselves, but the unit-characters of which they are composed. The origin of a new

variety would then consist in the acquirement of a new character by the organism or the loss of an old character or of the production through hybridization of new combinations of characters that already existed but in different combinations.

Nature of variation.

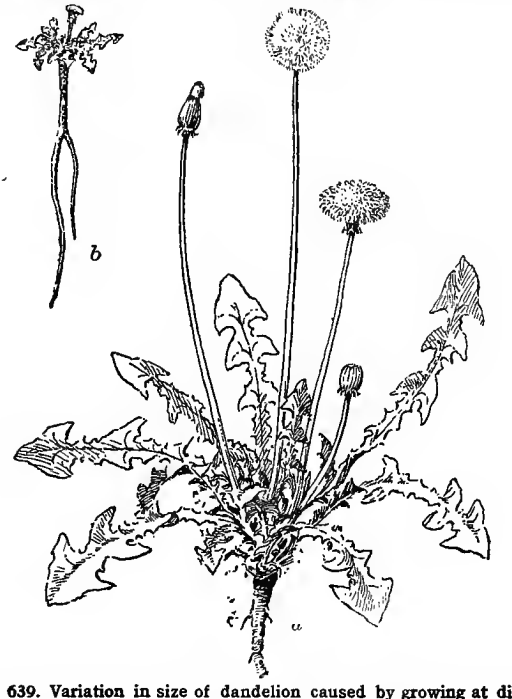
While, as indicated in the discussion of heredity, organisms are usually reproduced in the likeness of their parents, nevertheless it is well known that all plants vary. Individual plants differ from one another just as do men. The fact that plants can be improved by selection depends upon the occurrence of these so-called variations. One is accustomed to think of plants as very stable and uniform. Casually looking over a field of ox-eye daisies and admiring their beauty, one distinguishes no apparent variability; all seem to be alike. Nevertheless, if the plants are examined carefully and the different individuals studied, it is found that each one possesses certain peculiarities. Some have large flower-heads, others small flower-heads; some have very many rays or petals, others comparatively few; some have broad rays, others narrow rays. Some plants are tall, others short. No two plants can be found which do not differ from each other in some noticeable character. They present different facial expressions, the same as do people or cattle, so that different individuals may be recognized after one has studied them and made their acquaintance. This is one of the interesting studies which the breeder pursues. Careful gardeners learn to recognize the individual plants that they handle day after day as the shepherd recognizes the different members of his flock.

The inheritance of a character ordinarily does not mean its exact expression in the offspring as in the parent. In considering variations from the standpoint of the conception of unit-characters, it must be remembered that only the determiners of a character are inherited and the expression of the character in the new individual is influenced by the environment under which the individual develops. It must also be remembered that in the higher plants and animals with which the breeder ordinarily has to deal, an individual results from a fertilized egg-cell which contains the heritage determiners of two parents and, as there are a very large number of characters making up any individual and as different individuals possess different determiners which are brought together in fertilization, rarely or never can one individual be conceived to be an exact counterpart of another.

Variations are of very great difference in magnitude and kind; and while many different names have been given to the different types of variation, the most generally accepted usage at present is to classify all variations either as fluctuations or mutations.

Fluctuations are those variations that are supposed to be due to the direct action of environment and that are not inherited. The variation in size as a result of richness of soil, is such a fluctuating variation and, as well recognized, is not a heritable character. A similar illustration of such a variation is the difference in size of oat or wheat plants due to crowding in the field (Fig. 637). It is known that if a pole bean be transferred to the North, it tends to produce a bush type, and if a cowpea be transferred to the North, it tends to shorten up its vine and assume a bush habit. An interesting illustration of such modifications is shown in the ordinary red cedar, *Juniperus virginiana* (Fig. 638). In the rich, moist soils of Pennsylvania, Maryland and Virginia, this tree forms a beautiful tall columnar top with dense foliage (Fig. 638 *a*). On the dry, sterile, limestone hills of Kansas, Nebraska, and Kentucky, and in the sandy soil of Florida, the same tree produces a spreading, scraggly top of entirely different character (Fig. 638 *b*). If one of these trees is transplanted while young, from sterile barren soil to moist rich land, it assumes the tall columnar habit as a result of the environment.

Plant-breeders have sometimes assumed that such modifications, which are the result of environment (Fig. 639), are of great importance to them. This matter, however, is in grave doubt. The information at command indicates that these characters, which are physiological adaptations, are not hereditary, and are lost as soon as the plant is transferred again to its normal environment. If, for example, it is desired to produce a bush cowpea and the selection is undertaken in the South with a viny variety, a search should be made among the plants for the individual that approaches most nearly to the bush type, and it is probable that this plant would be as likely to transmit this character to its progeny as a similar bushy type selected under northern conditions. As a matter of fact, it may be that this tendency could be recognized much more



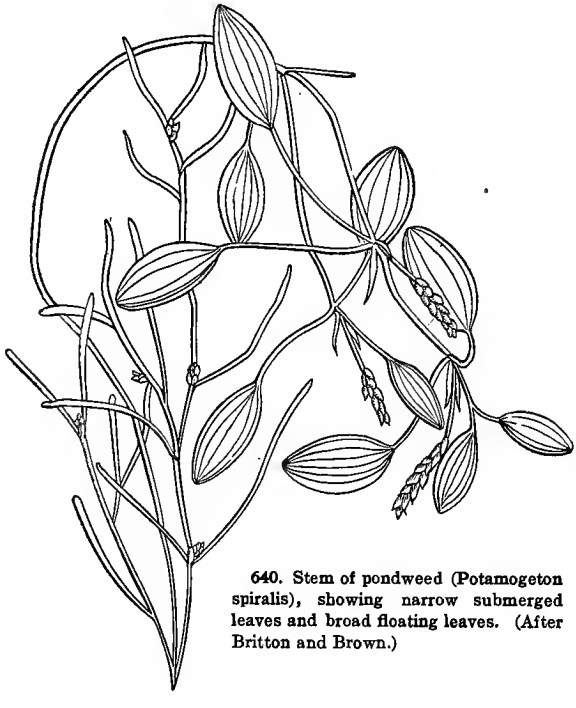
639. Variation in size of dandelion caused by growing at different altitudes. *a*, Plant grown in valley at low altitude; *b*, plant grown on mountain at high altitude. (From Bonnier.)

clearly in a southern location, where the plants normally produce vines, than in a northern location.

Mutations, on the other hand, are changes that are more profound and effect the germinal cells of the organism in such a way that the changes are inherited. The most typical illustrations of mutations are the striking large type-variations that are known to gardeners as sports, and which ordinarily reproduce true to seed. It must not be understood, however, that all mutations are large type-variations. This, it is true, was in large measure the meaning given to mutations by DeVries in his development of the mutation theory of evolution, but the more general interpretation of biologists at present is to consider any type of variation that is inherited as a mutation. Many small variations, such as a slight difference in height of ear in corn, may be regularly inherited, and in some instances differences that are so slight as to be distinguished only by careful biometrical analysis are regularly inherited, generation after generation, even under very different conditions. Recent scientific studies have emphasized

the great importance of such variations in the production of cultivated varieties and the evolution of species. As is well known to gardeners, these sports or mutations appear suddenly without warning or reason, so far as is known. They cannot be produced, and one must simply wait until they appear and then be prepared to recognize and propagate them. Mutations usually reproduce their characters without much reversion to the parental type except such as is caused by cross-pollination. Mutations of self-fertilized plants thus usually come true to type, while in cross-fertilized plants the mutation must usually be cultivated in an isolated place and carefully selected to weed out the effect of such crossing as has occurred. Many seedsmen examine their trial-grounds regularly for sports or mutations, and many of the best varieties have resulted from the selection of such sports. Livingston, of Ohio, who during his life was famous for the number of new varieties of tomatoes which he produced, made it a practice to search regularly the fields of tomatoes, which he grew for seed purposes, for such sports, and almost all of his numerous varieties were produced by the discovery of such striking variations.

A very interesting case of a variety that originated as a seedling sport or mutation is the now familiar case of the Cupid sweet pea. Until about fifteen years ago the only sweet peas known were the ordinary tall twining sorts which grow to a height of 3 to 6 feet, depending upon the richness of the soil. At this time there was found in California, a small dwarf sweet pea plant only about 6 or 8 inches high. This was growing in a row of the Emily Henderson variety, one of the ordinary tall sorts from which it evidently had sprung. Seed of this



640. Stem of pondweed (Potamogeton spiralis), showing narrow submerged leaves and broad floating leaves. (After Britton and Brown.)

dwarf plant was saved and grown, and it was found to reproduce plants of the same dwarf character. The variety was designated the Cupid, under which name it was introduced to the seed trade and distributed over the world. The Cupid differed from other sweet peas not only in height but in its closely set leaves and general habit of growth. Indeed it is as distinct from other sweet peas as are distinct species of plants in nature. From the original Cupid, there have sprung many different sorts, until now there are varieties of Cupids representing almost all variations of color and shape of flower known in the sweet pea family.

Causes of variation.

Understanding of the causes of variation is as yet very imperfect. Fluctuations are in general interpreted as the direct physiological action of environment on the plant, or, in other words, environmental reactions. There would seem to be no doubt of the correctness of this view for the cause of ordinary fluctuations, and it may be accepted as the cause of such fluctuating variations as the breeder will commonly meet. Such reactions as the changes in structure and form of the entire air-leaves and finely divided water-leaves of certain buttercups (Ranunculus) and the floating and submerged leaves of pondweeds or Potamogeton (Fig. 640), and the loss of knees on the bald cypress when cultivated on high land where the soil is well aërated, may be interpreted merely as extreme environmental reactions. Even these extreme changes are not inherited other than that the ability to react in this way under different environments is inherited.

To account for mutations is, however, a much more difficult matter and no definite conclusion as to their cause has yet been reached. Lamarck and his followers have strongly maintained the hypothesis that changed environment would stimulate the production of variations that would permanently effect the organism and its progeny in the direction of better adapting them to their environment. Many scientists, even today, believe in the effectiveness of environment in developing adaptive changes. Weisman and his followers, however, appear to have shown that characters acquired through external influences, the so-called acquired characters, do not affect the germ-cells, which are early differentiated in the development of the organism, and are thus not inherited.

While, in general, it is certain that the ordinary environmental reactions are not inherited, it is known that plants long grown under a certain environment become modified to suit that environment, and that such adaptive changes have in some way so modified the organism that the adaptive changes are rendered heritable. Thus the conclusion follows that in some way environment by its stimulation does occasionally affect the germ-cells and produce changes that are inherited. Plants that have long been cultivated under widely varying conditions almost invariably develop numerous heritable variations that would be classed as mutations. The older breeders strongly held to the belief that such conditions as change of food-supply, change of altitude, artificial cultivation, budding, and grafting, indeed the ordinary manipulation of agricultural cultivation, lead plants to vary in directions of importance to the breeder. Clearly, no problem is of more importance to the breeder than to be able to produce or cause such new characters to appear.

It is only very recently that the idea has developed that one can go farther than possibly to change the environment. With the publication of MacDougal's researches in 1906, describing mutations that were apparently caused by injecting the capsules of plants with certain solutions, such as zinc sulfate and magnesium chloride, a possible new method of forcing variations was introduced. MacDougal apparently obtained marked variations as a result of his treatment, that were inherited in succeeding generations.

Tower, by subjecting potato beetles during the formation of the germ-cells to extremely hot and dry or hot and humid conditions with changes of atmospheric pressure, was able to cause the development of marked changes or mutations that were found to transmit their characters true through several generations and which segregated as unit-characters following hybridization. He concludes from his experiments "that heritable variations are produced as the direct response to external stimuli."

Gager has produced similar changes in plants by subjecting the developing ovaries to the action of radium rays, and a number of similar studies by Hertwig and others indicate that radium emanations have a very active effect on both plants and animals.

While the evidence favoring the value of such external stimuli as the above in producing new heritable characters is apparently definite and positive, the extent to which the method can be used in

practical breeding has not been determined, and indeed further experience must be awaited before the evidence, or the interpretation of the evidence presented in these very valuable and suggestive researches, can finally be accepted. Humbert has made experiments in which the capsules of a pure line of a wild plant (*Silene noctiflora*) were injected with the solutions used by MacDougal, and although the number of plants handled (about 15,000) was apparently as great or greater than was used in MacDougal's experiments, no mutations were found in the treated plants that were not also found in the untreated or check plants.

Some observations and experiments are recorded in literature which indicate that mutilations or severe injury may induce the development of mutations. Most noteworthy among such observations are those of Blaringhem, who by mutilating corn plants in various ways, such as splitting or twisting the stalks, apparently produced variations that bred true without regression and which he described as mutations. Observations on the great frequency of striking bud-variations on recovering trunks of old citrus trees in Florida, following the severe freeze of 1894–5, also furnished evidence in support of this theory.

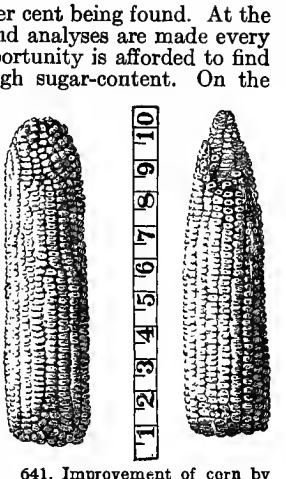
While the evidence at command regarding the artificial production of mutations is not yet sufficiently exact and trustworthy to enable one to draw definite conclusions and formulate recommendations for practical breeders, it may be stated that this is apparently one of the most profitable lines of experimentation for the immediate future

Principles of selection.

Selection is the principal factor of breeding, both in the improvement of races and in the production of new races and varieties (Fig. 641). The keynote of selection is the choice of the best, and a factor of the highest importance in finding the best is the examination of very large numbers.

In evolutionary studies, it has long been recognized that variation is the foundation of evolution and that no evolution is possible without variation; but, to selection has been assigned an all-important part as guiding and even stimulating the variation in a certain direction. Darwin, and particularly some of his more radical followers, have assigned to selection a creative force, in that it has been assumed that when nature by a slight variation gave the hint of a possible change in a certain direction, natural or artificial selection, by choosing this variation and selecting from among its progeny the most markedly similar variants, could force the advance in the direction indicated. Since Darwin's time, this cumulative action of selection had been emphasized so forcibly that selection had come to be recognized as an active force in creation rather than merely as a determinative agency.

It is certain, of course, that, by careful observation and selection from any particular race, ultimately a new race may be produced. The question is whether the individual or individuals selected in producing the new race have not varied by mutation or seed-sporting rather than being merely representative of the cumulative result of the selection of slight individual variations. The sugar-beet furnishes an interesting illustration in this direction. It will be remembered that Louis Vilmorin started the selection of sugar-beets for richness in sugar between 1830 and 1840, selecting first by means of specific gravity, the method being to throw the beets into solutions of brine strong enough so that the great majority of them would float, the few that sank being of greater specific gravity and presumably of greater sugar-content. Considerable improvement was produced by this method. About 1851, the method of chemical analysis was introduced to determine the exact sugar-content. At this time, the sugar-content was found to vary from 7 to 14 per cent, and in the second generation of selection individuals with 21 per cent of sugar were found. The selection based on percentage of sugar, using the beets highest in sugar as mothers, has been continued regularly since that time, and the industry has come to rely entirely on careful selection for high sugar-content. It would be expected that under these conditions, the percentage of sugar would have increased sufficiently so that the selected plants could be considered a different race or strain. Yet, after fifty years of selection, the highest sugar-content found is only about 26 per cent, and this in a very few instances, seldom over 21 per cent being found. At the present time, many thousand analyses are made every year, so that abundant opportunity is afforded to find individuals producing a high sugar-content. On the contrary, when Vilmorin's work was started, the determination of sugar-content was made by very laborious methods, and was limited to comparatively few individuals. It is not improbable that if Vilmorin had been able to make analyses of the sugar-content in many thousands of roots, he would have found certain individuals producing as high as 26 per cent. The inference from this illustration would be that the limitations of the variation within the race have not been surpassed as a result of selection.



641. Improvement of corn by selection. Boone County White corn on left, and original type from which it was developed by selection on right.

Of recent studies favoring the active influence of selection in creating or strengthening characters, the most noteworthy are those of Castle and Smith.

Castle and his assistants made an extensive series of experiments with hooded rats to increase the black-colored dorsal band on the one hand and to decrease or obliterate it, on the other. He appears to have obtained very positive evidence favoring the gradual cumulative action of the selection, as he succeeded in markedly increasing the amount of black in one strain until the rats were almost wholly black and in the other strain almost wholly obliterating the black. Castle has also obtained similar results in producing a four-toed race, and a change of coloring in guinea-pigs. His view may be summarized in the following quotation: "In Johannsen's view, selection can do nothing but sort out variations already existing in a race. I prefer to think with Darwin that selection can do more than this; that it can heap up quantitative variations until they reach a sum total otherwise unattainable, and that it thus becomes creative."

The experiments conducted by Smith and others at the Illinois Experiment Station on selecting high and low strains of corn with reference to oil- and protein-content, have resulted in markedly distinct strains possessing these qualities. Experiments have also been made in cultivating these varieties without selection and the new characters have been maintained for several years without marked regression.

The standard researches of DeVries, now familiar to all, challenged the correctness of the selection theory and sought to show that species originated by sudden jumps or mutations. It may be admitted that DeVries proved that species or new characters were formed suddenly as mutations, but this would not prove that they might not also be formed or actually induced to mutate by a continuous process of selection. Indeed, in his experiments on the production of a double-flowered variety of *Chrysanthemum segetum* ("Mutationstheorie," Vol. I, p. 523), a few generations of selection led to increasing markedly the number of ray-florets before the ligulate corollas appeared among the disk-florets, the change that he interpreted as the mutation that gave him the double variety.

Tower's experiments with the potato beetle in attempting to create by selection large and small races, albinic and melanic races, and races with changed color-pattern, although conducted carefully from ten to twelve generations, failed to give any evidence of producing permanently changed types. While strains of plus and minus varieties gave populations with a range of variation apparently markedly restricted to their respective sides of the normal variation range, still these selected strains did not greatly exceed the normal range of variation in either direction, and when the selection was discontinued, in two or three generations, again populations exhibiting the normal range of variation were produced. Jennings, in a series of selection experiments with paramecium extending over twenty generations, and Pearl, in an extensive experiment in the selection of chickens in an attempt to produce a breed of high egg-laying capacity, failed to secure any evidence favoring an accumulative effect of selection.

No series of experiments have had a more profound influence on the conception of selection than those of Johannsen, the Danish investigator. In studying commercial varieties of beans, he found that such characters as weight and size of seed fluctuated around a certain average, and when large seed or small seed was chosen, the progeny showed the influence of the selection, being smaller or larger in accordance with the direction of the selection. The progeny, however, did not exhibit the extreme sizes of the selected parents, there being a certain regression toward mediocrity. In investigating this matter, Johannsen was led to use the ordinary pedigree method of cultivating the progeny of different individuals separately and inbreeding or selfing all seed used to prevent the

crossing of different strains. By this method, he found that the progeny of each individual fluctuated around an average or typical size, as had the commercial varieties, but that while some strains were exactly the same in average size as the commercial variety, others fluctuated around a larger mean or a smaller mean than the commercial variety. He tried the experiment of selecting from these large and small strains extreme variants, and found that no advance was made as a result of the selection. He was thus led to conclude that in a pure self-fertilized strain from a single plant—what he called a pure line—no advance could be made by selection and that the commercial variety with which he first experimented was a mixed race. In the course of his experiments with pure lines, several variations were obtained which reproduced true to type, but these were interpreted by him as changes of type by mutation.

While, before the publication of Johannsen's results, breeders clearly recognized the importance of determining individual performance and using pedigree methods, still his pure-line conception was a distinct advance and forcibly brought to attention the fact that most commercial varieties and races consist of a number of distinct types—biotypes, as he called them,—and that much of our work of selection consists merely in isolating and purifying these types.

Is one, then, to conclude that the practice of breeders in continually selecting from the best for propagation is useless, and must one advise practical breeders to discontinue their selection? There can be no doubt that the practical breeders have made advances by selecting from the best individuals. No scientific breeder will deny this. It is simply the question of the interpretation of how the results were secured that is in doubt and whether these results can be considered as permanent new unit-characters.

It appears that one is dealing in breeding with two markedly distinct types of selection, based on different principles and arriving at different results, both correct in principle and productive of equally valuable practical results, but of very different value when considered from a strictly evolutionary standpoint. The first of these types would be that in which mutations are selected and new races established, while the second would be illustrated by that type of selection which is intended merely to maintain a maximum strain of the race.

It would seem that such cases of improvement as are illustrated by the sugar-beet indicate that the continuous selection, generation after generation, of maximum fluctuations shown by a character, will result in maintaining a strain at nearly the maximum of efficiency; and that within a pure race the progeny of a maximum variate which would probably be classed as a fluctuation, does not regress entirely to the mean of the race in the first generation succeeding the selection, but that there is only a certain percentage of regression similar to the regression determined by Galton.

These races or selected strains maintain themselves as long as the selection is continued, and when the selection is discontinued rapidly regress to the mean of the species.

The practical breeder should clearly recognize that the act of selection, the choice of the best, remains just as important whether it has a cumulative effect, thereby augmenting the character, or whether he is merely purifying an already existing superior race. The final result remains the same.

Methods of selection, or pedigree breeding.

By methods of selection is meant those practices that the breeder uses to find promising variations, determine their value, and purify or develop them into fixed races coming true to seed.

Choosing superior plants.

The first concern of the breeder is to find the valuable variations. How he had best do this will depend largely upon the plant with which he is working. In all cases, it is of the greatest importance to find the best possible plants and this is likely to require the examination of a very large number of individuals. This factor cannot be too strongly emphasized. If, for example, one attempted to find a man 7 feet high, one would probably have to examine, or pass over, a million individuals to find him. The superior individuals fitted to be the progenitors of a new or improved race are very few. Certain individuals far above the average may be found by examining a comparatively limited number, but the very best possible individual is but rarely produced.

The plants from which selections are to be made should be grown under as uniform conditions as possible, so that the experimenter may have opportunity to examine and select the best. Two methods of growing plants for selection are in general use, and may be termed the nursery method and the field method.

The nursery method, which was first used by Hallett about 1868, consists in cultivating each plant under the most favorable conditions possible for its best development. By this method with wheat, for example, Hallett pursued the policy of planting the indidivuals in squares a foot apart, which would give each plant abundant opportunity for stooling, and also the investigator an opportunity clearly to distinguish each individual plant and determine its characteristics, total yield, and so on. In recent years, this method of growing the individual plants at a standard distance from each other, in order to test their yielding capacities and the like, has been used very extensively.

The field method was used by Rimpau about 1867, and probably by many others before that time. By this method, the selections are made from plants grown under normal field conditions. The advantages of this method are that it can be judged only what a plant will do in the field under ordinary conditions of field culture, by growing and selecting it under these conditions. In the large majority of cases, the first selections are probably made from plants grown in the field in the regular course of crop-production, which thus were not specially grown for the purpose.

If one is to use the nursery method, the plants must be especially planted. While the nursery method certainly allows the breeder to distinguish the individual plants more clearly, in wheat, oats, and other crops that are sown broadcast or drilled, it entails very much extra work and is probably to be recommended only for the use of experimenters who are giving their entire time to the work. In the greater number of horticultural crops, the individuals are normally cultivated one in a place, as in the case of tomatoes, cabbages, strawberries, currants and the like, and the examination of individuals in the field thus satisfies the requirements of both the above methods.

The breeder may have in mind either of two purposes in his work: (1) On the one hand, he may desire to secure an improved strain of a certain race, that is, by selection to keep his seed up to the maximum of efficiency. This may be called strain breeding. (2) On the other hand, he may desire to produce an entirely new race with different characters, and this may be called race-breeding.

He should clearly recognize which of these types of breeding he is following. As an illustration, suppose that the breeder is growing the Stone tomato and desires to maintain the best-yielding strain possible of this race. He would then attempt to choose from a very large number of plants of the Stone variety, the best-yielding plants having the largest number of perfect fruits and typical of the variety in habit of growth, quality, character of fruit, and the like, and would hope by a process of continuous selection to maintain his selected strain in a state of high productivity. This is the type of selection pursued by the sugar-beet breeders described earlier in this article.

On the other hand, if he desires to produce an improved new race, he would search among large numbers of tomato plants of any or all varieties for the appearance of mutations or sports, or plants of new type differing from any known variety. As a matter of experience,

it should be stated that it is very easy to find types of plants differing from the varieties or races ordinarily grown, but far the larger part of such variations are worthless types. Good new types, the superior or even the equal of the known varieties, are of very rare occurrence.

If the general improvement of a variety is the breeder's purpose, he should choose a considerable number of apparently superior plants of good type, which will form the basis of his selection work. Breeders who are conducting careful experiments will find it necessary and desirable to use careful methods of judging their plants. While one is breeding possibly for one primary improvement, as, for example, increased yield, it is necessary, at the same time, that one should keep the product up to the standard in other characteristics, namely, quality, disease-resistance, drought-resistance, and the like, and that one sees that all of the good qualities of the variety are retained. To do this properly necessitates the use of a score-card, on which each character of the plant that is important is given its relative weight or grade. By the use of such a score-card, the breeder can judge each character separately, and by the adding up of the score-card get the rank of different plants in a comparative way.

Inheritance test.—When a number of plants have been chosen, the next important factor is to test each individual as to its inheritance. It must be continuously remembered that a plant is valuable only as it produces good progeny. To determine the inheritance, the usual method is to plant the seed from each individual selected in a row by itself, or in a marked part of a row. This is the so-called "plant-to-row" method, and brings the offspring of a single individual together so that they may be readily compared with each other and their qualities carefully judged. These progeny rows should be grown in a special breeding-patch in which the soil is as uniform as can be secured.

It is frequently found that two select plants that are equally good so far as their yield is concerned will give progeny that, as a whole, differ greatly in this respect. In the progeny of one, almost every plant may have inherited the desired quality, while in the progeny of the other only a few of the plants may show, in any noticeable degree, the inheritance of the quality. To determine the degree of inheritance, it is necessary to grade carefully the progeny of each individual.

Finally, with the use of his best judgment, the breeder determines the superior progenies, and these would be the ones which have most nearly given the ideal type and produced the best yield of the highest quality. This would end the work of the first generation of the selection as the breeder now has the data which shows him which of the original plants selected was the superior one. It will be seen that this is a method of judging the individual by its progeny.

Continuation of the selection the second year.

Having determined the superior progeny or progenies at the end of the first year, the breeder then makes his selections of seed-plants from these best progenies for continuing the breeding. While one progeny may be and usually is superior to all others, this may be due to the season or other accidental conditions and for a few generations it is usually the best policy to make selections from several of the best progenies. Select from each of the superior progenies several of the best plants, using the same care in selecting these plants as was used in choosing the first plants. Preserve the seed from each of these plants separately and keep it carefully labeled so that its origin may be known.

The further work with these plants consists in planting each individual by the plant-to-row method, testing the inheritance as described in the first generation, and finally selecting again the best progenies. This would be followed by again selecting from the best progenies a number of superior individuals to continue the selections in the third year.

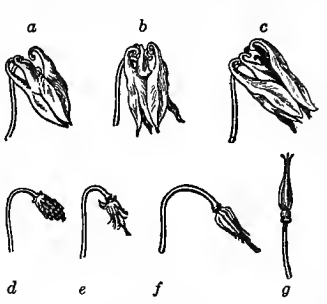
The third and succeeding years of the selection would be conducted in the same way as long as it was thought necessary or desirable to continue the work.

Securing general stock seed of the improved strain.

In carrying out selection work as outlined in the preceding section, it is ordinarily the object of the breeder to secure an improved strain of the race with which he is working, and usually he desires to utilize such improvements as he can make at the earliest possible time. With ordinary annual crops such as beans, peas, tomatoes, corn, and cotton, it will be found a good policy at the end of the second year of the selection, after taking the seed from the few special plants used in continuing the pedigree breeding, to harvest the seed from a number of the best plants remaining in the chosen progenies and using this seed to plant a multiplication plat from which stock seed may be secured to plant a fairly large crop. Each year following this, seed may be taken in the same way from the best progenies in the breeding patch to plant a multiplication plat. By this method, seed of a gradually improving grade may be secured for planting a general crop.

Control of parentage.

In plant-breeding, as in animal-breeding, the isolation of the parents is a very important consideration. It is necessary that the character of both parents should be known whenever this is possible. In breeding plants, more attention is given ordinarily to the mother parent, and in very many instances the characters of the father parent are entirely neglected. Animal-breeders, on the contrary, give more attention to the characters of the male parent, and much improvement in ordinary herds has been accomplished by the introduction of improved heritage through the male. In plant-breeding, it is desirable that the seed of the select individuals be planted in a field by themselves. This insures that only progeny of carefully selected individuals will be planted near together, and thus no ordinary stock will enter as a contamination. One can be certain that each plant of the progeny is fertilized with pollen from another similarly good plant, or at least from a plant derived from good parentage. One difficulty, however, has been experienced by plant-breeders in planting continuously their selected stock in such isolated plats. If this method is continued year after year, it results in fairly close inbreeding, which, in the case of plants, frequently results in loss of vitality and vigor. In animals there is frequently no noticeable effect from close inbreeding, and many of the most famous animals have been produced as a result of the closest in-and-in-breeding. In plants, however, it is possible to secure much closer inbreeding than in animals, as in many cases a plant can be fertilized with its own pollen.



642. Aquilegia flowers, illustrating the process of emasculation.

a, mature bud showing stage which should be chosen for emasculation; *b*, similar bud with the tips of the corolla pried apart and the stamens removed; *c*, a bud opened naturally, too old to operate on; *d*, a bud of the stage shown in *a* and *b*, with corolla removed to show the internal organs; *e*, a bud the same as in *d*, but with the stamens removed; *f*, the same as *e*, but older, at the age when pollination normally takes place; *g*, pistil shortly after fecundation, the remnants of the stamens having fallen away.

Within recent years, much activity has been shown

in the careful breeding and improvement of corn. The corn plant has been shown, as a result of experiments made by various investigators, as, for example, the Illinois Experiment Station and the United States Department of Agriculture, to lose vitality very rapidly when self-fertilized. Within three or four generations, by the most careful inbreeding, it is possible to reduce corn almost to total sterility. The general practice of corn-breeders who have been giving attention to the production of pedigree strains is to plant the rows of corn from different select ears side by side, giving a row to each select ear, and each year selecting, from the progeny of those rows that give the largest yield, plants to continue further the selection. Planting these select ears together every year, therefore, means that they are more or less inbred, as the closest relatives are planted together in the same row. While in following this practice at first no effect was visible, corn-breeders are now finding in some cases an apparent decrease in yield, which seems to be traceable to the effect of inbreeding. It seems necessary, therefore, in corn and in other plants that are affected by inbreeding, to use methods that will avoid close inbreeding. The detrimental effect of inbreeding is largely limited to those plants that are normally cross-fertilized, this fact being strikingly brought out in Darwin's "Effects of Cross and Self Fertilization in the Vegetable Kingdom." Tobacco, wheat, and some other plants that are normally self-fertilized do not show this decrease in vigor as a result of inbreeding.

643. Plant of aquilegia with flowers covered with bags in hybridization work.

Considerable effort has been made within recent years, in the selection of certain crops, particularly corn, to follow both parents, choosing good males and good females of known parentage and crossing these by artificial means. There can be no doubt but that by the use of such methods more rapid progress could be made, but in the greater number of cases the methods thus far devised require so much work as to be almost prohibitive.

A method of breeding has recently been devised by J. B. Norton in the improvement of asparagus, which is worthy of careful consideration and may be applicable, at least in modified form, to use in the improvement of various crops. Asparagus is dicœcious, the male and female flowers being borne on different plants. The first part of the process consists in selecting a number of superior plants of both sexes, attention being given to all important characters such as yield, quality, rust-resistance, and the like. This having been done, the next process consists in crossing each female with each selected male plant and testing the progeny produced by the cross. If, for example, ten superior females and ten superior males were chosen, a sufficient number of flowers on female No. 1 would be crossed with pollen of each of the ten males to obtain sufficient seed to test the comparative value of the progeny of female No. 1 with each of the ten males. The ten lots of seed from the crosses on female No. 1 would be grown separately and the comparative value of the different progenies determined by careful observations on vigor, rust-resistance, quality of product, yield, and the like. In this way, it would ultimately be determined which of the ten male plants was the superior one to use in crossing with female No. 1. In like manner, female No. 2 would be crossed with each male and the progenies tested to determine the superior male in this combination. Finally the combination of each female with each male can be compared and if the work has been conducted with sufficient care and for a long enough period, it can be determined which combination has uniformly given the best results.

Asparagus is perennial and is easily propagated vegetatively by separation of the roots, so that when once the superior male and female combination has been determined, these may be propagated vegetatively as clons, in alternate rows in an isolated place so that all seeds developed will be of the desired combination. Asparagus produces numerous seeds and by such a method an indefinite quantity of seed of the desired combination can be produced. It would doubtless be possible in a few years, if desired, to have all of the seed used commercially grown from a single superior combination.

If experiments of this nature could be made on an extensive scale so that the males and females of the highest or maximum grade could be discovered, they would be of almost fabulous value. The importance of this method of breeding may be better appreciated by imagining the value of the best bull and the best cow in the world if they would live indefinitely and if it were possible for them to reproduce rapidly enough to supply all of the individuals desired.

The direct application of this method is possible only with perennial dicœcious plants that can be propagated as clons and that develop numerous seeds. The hop is another plant to which this method of improvement could be applied.

Hybridization.

Aside from selection, hybridization has played the most important rôle in the formation of the varieties and races of our cultivated plants; but the results obtained are in many cases closely connected with selection. Ever since the time of Knight, hybridization has been used extensively in plant-breeding, and it seems that this is the only sure means that the breeder can use in producing new and desirable combinations of characters. In hybridization, as generally used, the breeder does not expect to cause or produce new unit-characters, although such changes may occasionally occur under the stimulus of hybridization. What he can do with certainty is to secure hybrids combining the different characters of two distinct sorts. The extent to which such recombination of characters can be carried is almost unlimited. In many cases, two or three or even four distinct species and the characters represented in their various varieties have been recombined in hybrids.

In older literature, the term hybrid was restricted to crosses resulting from the combination of distinct species, while combinations of different races of the same species were known as crosses or mongrels. The term hybrid is here used as designating any product of a cross when the parents were noticeably distinct from each other, whether the parents belonged to different clons, races or species. This broader use of the term hybrid has become almost universal in recent years. If, in discussion, it is necessary to refer to the degrees or grades of difference in the parents, the hybrids may be characterized as species hybrids, racial hybrids, clonal hybrids and the like.

Choosing varieties to hybridize.

In starting any work in hybridization, the first important step is the choice of the varieties to be hybridized. It is interesting to make crosses of any two plants with distinct characters and observe the recombinations of characters which result, but this haphazard work takes too much time and is not to be recom-

mended. The breeder, in general, should hybridize with some definite aim in view and use systematic methods in attempting to accomplish that aim. One cannot ordinarily expect to obtain in hybrids of any two varieties any characters which are not present in the parents. The unit-character conception explained in the beginning of this article is of fundamental importance in understanding hybrids. The breeder, by a careful study of varieties, determines the good characters and the poor or weak characters of each variety. He may, as an illustration, if working with tomatoes, find all of the varieties with yellow pear-shaped fruits to be large bushy plants, the so-called standards, and he may desire a dwarf type of plant and red fruits. By examining the different races of tomatoes, he would soon find a variety, such as the Quarter Century, which possesses the characters of dwarf plant and red fruit. By crossing these two varieties, he would obtain new combinations of the characters of the two sorts, and if he grew a sufficient number of the second generation of these hybrids, he would be certain to find some plants in which the pear-shape had been combined with the red color and dwarf habit of the Quarter Century variety.

The study of the varieties of any crop thus gives the breeder an idea of the characters available, and he must then use his originality and judgment in determining what combinations of these characters would form the best commercial variety. If this combination does not already exist, he may start out with considerable confidence that it is possible for him to obtain such a combination and thus a valuable new variety. Plants, however, are not simple in their organization and the reaction of different characters on one another in different combinations may not always be what one expects. Again, in no plant has a complete analysis been made of all characters, and it may be impossible for us ever to reduce all the characters of a plant to a unit-character basis; thus there is always an element of doubt as to the value of any new combination of characters until this combination has been produced and tested.

Methods of crossing plants.

Plants, like animals, bear male and female organs, and an act of fecundation is necessary in all ordinary cases to insure the development of seeds. In probably the larger number of plants, the male and female organs or the stamens and pistils are borne in the same flowers on one plant. In some cases, as in the castor bean, corn, and the like, both sexes are borne on the same plant but in different flowers. In still other cases, as in the date palm, asparagus, hop and hemp, the sexes are on different plants.

In hybridizing plants, it is necessary to insure that the plants are not fertilized with their own pollen or with pollen from any other source than that desired. If, therefore, the plant to be operated on has the stamens and pistils in the same flower, the stamens must be removed from the buds before they burst and discharge the pollen. This act of removing the stamens, or emasculation, as the process is called, is necessary in order to prevent self-fertilization. In some plants, it is necessary to emasculate the buds very early, as the pollen developa considerably in advance of the pistils. In other cases, the pistils reach maturity or a receptive condition before the pollen is shed. In this latter case, the emasculation may be delayed until a time just previous to the normal opening of the flower.

The process of emasculation may be illustrated by the columbine. Here large-sized buds are chosen just before they open normally (Fig. 642). The tips of the petals can then be easily pried apart so that the atamens may be pulled off with small forceps. This process should be performed carefully to avoid crushing or injuring the pistil. The bud should then be inclosed in a small light paper bag in order to prevent pollen from any foreign source being brought to the pistil by insects or wind (Fig. 643). The bud should remain covered until sufficient time has elapsed to allow the pistil to reach normal maturity, when the bag should be removed and the pollen from the desired variety dusted over the pistil. After this act of pollination, the bud should again be covered with the paper bag, which should not be finally removed until several days later, after fecundation has taken place. As soon as a flower is pollinated, it should be labeled with a small tag of some sort which may remain attached to the flower-stem until the fruit is ripe. In some cases, the pollen may be placed on the immature pistil without injury, when the flower is emasculated, and this is a great saving of time when it can be done. However, in most cases, premature pollination is liable to injure the pistil and prevent the setting of seed. One should ordinarily attempt to pollinate the pistil at as nearly the normal time as possible. Many plants are difficult to hybridize and every process must be as natural as possible to insure results.

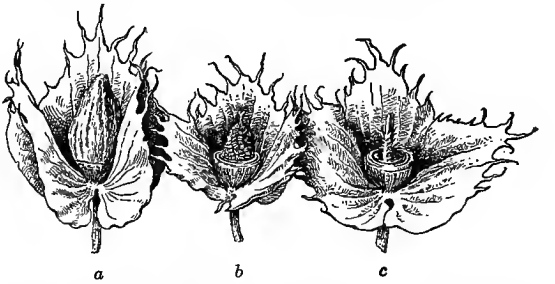
Many handy methods have been devised to use in pollination work and are described in breeding literature. In all work fine copper wire is better to attach bags and labels than is string. In emasculation work also, it will often be found convenient when some pollen has accidentally fallen on the pistil to wash it off with water by means of a small dental syringe. In many cases, such as apples, pears and cotton, the best means of emasculation is to remove the outer floral envelopes by cutting them off, using a sharp scalpel. With a little practice this can be done quickly and with minimum injury to the essential organs (Fig. 644).

Difficulty is frequently experienced when hybridizing different varieties, in getting plants of each variety to bloom at the same time. This difficulty may he overcome in many cases by keeping the pollen, which can be done for a limited period by slightly drying the pollen without allowing it to become desiccated, and preserving it in a tightly corked bottle.

After the pollen has been placed on the stigma of the pistil by the act of pollination, each pollen-grain developa a small tube which grows down through the pistil to the ovary. Through this tube, the male germ-cells pass down and finally a male germ-cell comes in contact with each egg-cell of the different ovules in the ovary (in most plants there are several ovules in each ovary) and fuses with them. This constitutes the act of fecundation or fertilization. This fecundated egg-cell is then the beginning of the hybrid and from the seed containing it, when grown, there develops the hybrid plant. The plant developed directly from this hybrid egg-cell is known as the first-generation hybrid (F_1). Seeds from this first-generation hybrid, when grown, give second-generation hybrids (F_2). The expressions F_1, F_2, and F_3, meaning first, second and third filial generations, are used very commonly to designate the first, second and third generations of hybrids.

Laws of inheritance in hybrids.

When plants of different pure races are crossed, as, for example, different races of wheat, corn or cotton, the hybrids are usually all very similar to each other in the first generation, exhibiting in general the same characters. And this is the case also when different fixed species are crossed. If, however, individuals belonging to unfixed races are crossed, there is usually a considerable variation in the first generation. This is well illustrated by the crossing of different clons of apples, pears, oranges, and the like, when the different so-called varieties are merely transplanted parts of the same individual seedlings which have not been bred to a purity of type. It is well known that if seeds of an apple variety be planted, the resulting plants exhibit many different variations in the first generation. The parents, themselves, therefore, not being of pure type, when they are hybridized produce progeny which in the first generation is variable. In the crossing of races which have been bred true to type, whether of the same or of different species, the first-generation hybrids, however,



644. Cotton flowers, illustrating the process of emasculation.

a, mature bud showing the stage which should be chosen for emasculation; *b*, a similar bud with the corolla cut off ready to emasculate; *c*, a similar bud with the stamens removed,—emasculated.

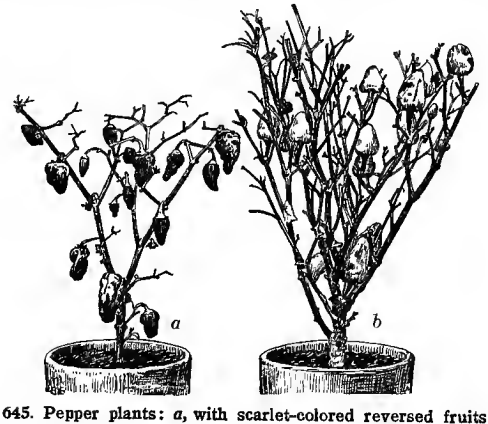
are nearly uniform in the characters presented, and in such instances it is necessary to secure a second generation of the hybrids in order to accomplish the segregation of the characters and the production of a large number of variations. Ordinarily, therefore, desirable variations are looked for in the second generation. This, as has been explained above, is true only in the case of hybrids of species and races that are fixed in type.

Mendel's law of hybrids.

The preceding discussion represents fairly well the general understanding of hybrids until about 1900, when DeVries and Correns rediscovered what is now termed "Mendel's law of hybrids." These laws or principles are of great value from an economic standpoint, and are, furthermore, of the greatest scientific interest. They should thus be thoroughly understood by every practical breeder of plants. It has been known for many years that a splitting-up and redistribution of parental characters occur in hybrids, and it is on this fact largely that the practical application of hybridization in plant-breeding depended. Until Mendel's law was discovered, however, there was no understanding of why or how such a recombination could be made, and it was necessary to experiment extensively in order to determine what could be accomplished.

If one carefully studies a number of first-generation hybrids with special reference to the characters of the parents exhibited in the hybrids, it will be found that certain characters possessed by the male parent are plainly represented in the hybrid, while other characters possessed by the female parent are also represented in the hybrid. Many characters of the parents are thus plainly represented in the hybrid, but it is probable that other characters will be blends of the similar parental characters, or possibly differ from any definite characters distinguishable in the parents. Attention has already been called to the complexity of organisms in general and the difficulty of recognizing all of the unit-characters. Thus far it has been possible only to follow carefully certain plainly marked characters. This commingling of the different characters of each parent gives the hybrid a mosaic appearance, as if certain characters had been taken from each parent and thrown together to make up a hybrid individual.

Character-pairs.—To understand this commingling of characters in the first-generation hybrids, it is necessary to know that the parents used in the hybridization differed from each other in certain characters. One parent may have had red fruits, hairy stems, and dwarf habit, while the other may have had yellow fruits, smooth stems, and tall habit. Such characters are opposed to each other, and such opposed qualities or characters are termed "character-pairs." A plant may have red fruits and smooth stems, but it could not have red fruits and yellow fruits at the same time. As an illustration of such character-pairs, may be cited, scarlet and yellow fruits of peppers, reversed or erect fruits of peppers (Fig. 645), starchy and sweet kernels of corn, standard and dwarf size in tomatoes, stringy and stringless pods of beans, and the like. Such pairs of characters have been termed by Bateson "allelomorphic pairs of characters," and this terminology is commonly used in the literature on hybrids. When parents possessing opposed or contrasted characters are crossed, the hybrid egg-cell receives, through the male and female germ-cells uniting in the fecundation, the determiners which represent the different contrasted pairs of characters, and all cells making up the first-generation hybrid will contain in like manner the determiners representing these characters, and are thus hybrid in nature. This being the case, it might be expected that all characters in the hybrid would show as blends of the parental characters or exhibit some stage of intermediacy between the characters of the parents. This is indeed frequently the case, but more commonly one of the characters is very strong, or "dominant," as Mendel expressed it, and only this character will show in the first-generation hybrid, the other character remaining recessive or masked, although present. As an illustration, in the character-pairs mentioned above, scarlet fruits of pepper, reversed fruits of pepper (this is true only in certain varieties), starchy kernels of corn and standard size of tomato plants, are dominant over their corresponding contrasted characters. Illustrations of blended or intermediate characters are found, for example, in first-generation hybrids of round with pear-shaped tomatoes, and large with small fruits of tomatoes or peppers.



645. Pepper plants: *a*, with scarlet-colored reversed fruits; *b*, with yellow-colored erect fruits. The number and form of branches are also markedly different.

The law of segregation and purity of the germ-cells.—The second important principle of Mendel's law is what is termed the law of segregation and purity of the germ-cells. It seems certain from the researches that have been conducted that, when the germ-cells of the first-generation hybrids are formed, the determiners which represent the two different characters under consideration, and which were united by the hybridization, ordinarily segregate again in the cell-divisions, which lead to the formation of the germ-cells, so that certain germ-cells include the determiner of one only of the two characters. There are thus two kinds of germ-cells formed with respect to this one character-pair. Choosing as an illustration a hybrid of a pepper having scarlet fruits with one having yellow fruits (Fig. 645), when the germ-cells were formed a segregation of the determiners representing the two opposed characters would take place and there would be germ-cells of one kind, both male and female, containing the scarlet fruit determiners and of a second kind, both male and female, containing the yellow fruit determiners. This segregation takes place in the formation of both the egg-cells and the sperm-cells or pollen-grains. It is thus seen that the first-generation hybrid, when two such allelomorphic characters are combined, forms two kinds of egg-cells and two kinds of sperm-cells, so far as this one character-pair is concerned. This segregation of characters, which has been termed the law of segregation, is one of the most important facts of inheritance and, in enabling us to get recombinations of characters, is of the highest importance in breeding.

The law of probability in recombination of characters.—The third important principle of Mendel's law is what is termed the law of probability, and explains what may be expected in plants of the second generation of such a hybrid. Remembering that there are formed in the first-generation hybrid, as explained above, two kinds of egg-cells and two kinds of sperm-cells with reference to the opposed characters, what would happen if the hybrid were bred with its own pollen; or, in the case of an animal, if it were bred with another hybrid of the same parentage? For the purpose of illustration, suppose that a hybrid of a scarlet-fruited pepper with a yellow-fruited pepper be fertilized with its own pollen, and that 100 egg-cells be fertilized with 100 pollen-grains of the same hybrid. There are two kinds of egg-cells produced, some carrying determiners of the scarlet fruit, and others determiners of the yellow fruit, and the same is true of the pollen-grains. Taking the egg-cells and pollen-grains without choice, as equal numbers are produced of each kind, one would expect to have of the egg-cells fifty with scarlet determiners and fifty with yellow determiners. In the pollen-grains, also, one would expect to have fifty with scarlet determiners and fifty with yellow determiners. If, then, the 100 egg-cells and 100 pollen-grains are brought together in fertilization by chance, as would occur in nature, according to the law of probability, there would be twenty-five scarlet uniting with twenty-five scarlet; twenty-five scarlet uniting with twenty-five yellow; twenty-five yellow uniting with twenty-five scarlet; and twenty-five yellow uniting with twenty-five yellow. Representing scarlet determiners by the capital letter S because scarlet is the dominant character, and the yellow determiners by the small letter y, as yellow is recessive, the unions may be represented as follows:

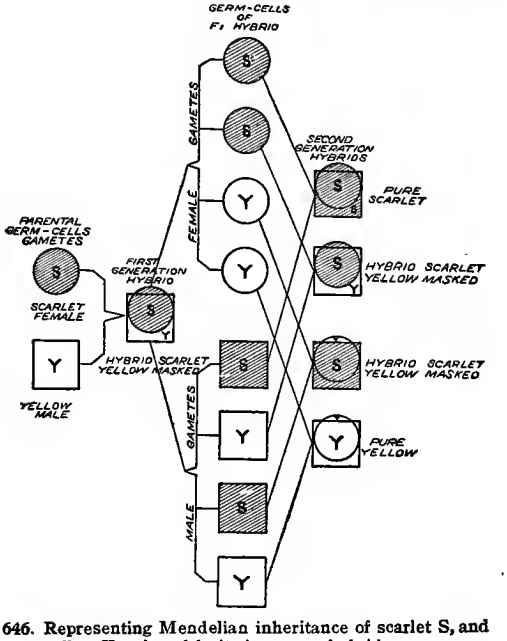
ONE HUNDRED EGG-CELLS BY 100 SPERM-CELLS.

Female Cells		Male Cells		Composition of hybrids	
25 S	×	25 S	=	25 SS	These do not contain determiners of y and will reproduce true.
25 S	×	25 y	=	25 Sy	These are hybrids so far as this character-pair is concerned,—exactly the same as in the first generation and contain determiners of both S and y. These will not reproduce true to type and will break up like second-generation hybrids.
25 y	×	25 S	=	25 yS	
25 y	×	25 y	=	25 yy	These do not contain the determiners of S, and will reproduce true.

The above illustration explains the law of segregation, and the probable ratio of recombination when hybrids are inbred with their own pollen, and when only one pair of characters is considered. When an egg-cell with scarlet determiners unites with a sperm-cell with scarlet determiners, this gives rise to a pure germ-cell, or zygote, containing only scarlet determiners, and the progeny in subsequent generations will breed true so far as this character is concerned. Also, when an egg-cell with yellow determiners unites with a sperm-cell with yellow determiners the result is a pure germ-cell, containing only yellow determiners and the progeny would reproduce true, so far as this character is concerned, in subsequent generations. In the other two cases, when in fecundation

gametes with scarlet determiners unite with gametes with yellow determiners giving the combinations Sy and yS, which amount to the same thing, there result in reality, hybrids exactly the same as in the first generation and the progeny from these in the next generation behave exactly the same as did the first-generation hybrids in the second generation.

In such a case as the one under consideration, in which the scarlet is a strong dominant character, all combinations that contain the determiners of this character, whether pure or of hybrid nature, show this character only. Thus in the above 100 combinations the twenty-five yy would come with yellow fruits while the seventy-



646. Representing Mendelian inheritance of scarlet S, and yellow Y, color of fruits in pepper hybrids.

five other combinations would have scarlet fruits, although fifty of these would be of hybrid nature. To determine which of these seventy-five scarlet-fruited plants are the combination Sy, that is, scarlet with yellow, and which are SS, that is, scarlet with scarlet, requires the growing of self-fertilized progeny from them to determine which are reproduced true to type, as these would be the pure scarlet. The progenies of any of these plants that produced both scarlet- and yellow-fruited plants would show that the parent of such progeny was a hybrid.

In the hundred combinations there is thus produced a ratio of one pure scarlet to two hybrid scarlet and yellow to one pure yellow, 1 SS:2 Sy:1 yy. or three scarlets to one yellow and this is the famous 3:1 Mendelian formula.

This process of union of an allelomorphic pair of characters in hybridization, the formation of four kinds of germ-cells, both male and female, by the hybrid, and their four different unions, is graphically illustrated in Fig. 646.

While in certain hybrids of parents possessing two opposed parental characters, this ratio of probabilities is not produced, if large numbers are used the ratio will be found in many cases with little deviation. A sufficiently large number of cases have now been studied with various plants and animals to place this conclusion beyond question. It is not known, however, how many characters follow Mendel's law, nor is it yet entirely certain whether those character-pairs that sometimes follow the law of segregation always follow it.

The individuals of the second generation which contain the determiners of both characters of the pair, if self-fertilized or bred with similar individuals containing the determiners of both characters, exhibit in the third generation exactly the same nature that first-generation hybrids exhibit in the second generation. The two determiners are commingled in their cells, and to all intents and purposes they are exactly the same as first-generation hybrids. When such self-fertilized hybrids are grown they give again, in the third generation, the regular Mendelian proportion of 1 SS:2 Sy: 1 yy. Here the individuals containing only determiners of one character, that is, SS and yy, would come true to these characters in succeeding generations, while those individuals containing the determiners of both characters, S and y, would be expected to segregate again in the fourth generation in similar proportions.

When dealing with more than one character-pair, ratios of segregation become complicated but are easily understood. If the character of reversed fruits (R) and erect fruits (e), two plainly marked characters of ordinary garden peppers, caused by the pedicel of the fruit curving backward in one case and remaining straight in the other, are combined with the above allelomorphic characters, it can be foretold exactly what combinations will occur and the relative number of each. This is a second allelomorphic pair of characters that behaves in inheritance the same way as did the two colors of fruit. In this case, the reversed pedicel is the dominant character, as in the F_1 hybrids of reversed with erect sorts the pedicels are always or very generally recurved. These characters would thus be represented by R for the recurved or dominant character and e for the erect or recessive character. In this character-pair one would expect a splitting and segregation to have occurred in the formation of the germ-cells of the first generation so that the hybrid plants of the second generation would exhibit these characters in Mendelian proportions as in the character-pair first described. The progeny in the second generation would thus exhibit these characters in the following combinations and proportions: 1 RR:2 Re:1 ee. This theoretical proportion should hold rather constantly, either in small or large numbers of hybrids, though in large numbers it would be more nearly realized. The determiners of the four characters, or two character-pairs, are commingled in the cells of the first-generation hybrid. When the egg-cells and pollen-grains are formed, however, a segregation of the determiners of the two character-pairs occurs, but independent of each other. Each egg-cell or pollen-grain will receive only the determiner of one character of a certain character-pair but will, at the same time, receive determiners of other characters belonging to other character-pairs. Considering the two character-pairs described in peppers, an egg-cell receiving the determiner of the scarlet color of fruit S, might also receive the determiners for either R or e representing the characters of recurved or erect fruits. These two character-pairs would thus give egg-cells of four combinations, SR, Se, yR, and ye.

In the formation of the pollen-grains, the same combination occurs, so that with reference to the two character-pairs described, the pollen-grains that would be formed have the same combinations of determiners as the egg-cells, namely, SR, Se, yR, and ye. There would thus be four kinds of egg-cells and four kinds of pollen grains so far as these two character-pairs are concerned. If these are brought together, sixteen combinations are possible as follows:

SRSR	SeSR	yRSR	yeSR
SRSe	SeSe	yRSe	yeSe
SRyR	SeyR	yRyR	yeyR
SRye	Seye	yRye	yeye

Examining these combinations carefully, and placing together those combinations that contain the same character-determiners as indicated by the letters, and this can properly be done as it does not matter in the fecundated egg whether a certain determiner is furnished by the egg-cell or the pollen-grain, there result the following nine combinations, all of which are different in germinal constitution with reference to these two character-pairs:

TABLE SHOWING NUMBER OF GERMINAL COMBINATIONS AND CHARACTER OF F_2 PEPPER HYBRIDS WITH TWO ALLELOMORPHS.

No. of combinations	Germinal constitution	Visual characters of hybrid	Nature of hybrid
1	SRSR	Scarlet recurved	Pure scarlet and recurved
1	SeSe	Scarlet erect	Pure scarlet and erect
1	yRyR	Yellow recurved	Pure yellow and recurved
1	yeye	Yellow erect	Pure yellow and erect
2	SRSe	Scarlet recurved	Pure scarlet and hybrid recurved × erect
2	SRyR	Scarlet recurved	Hybrid scarlet × yellow and pure recurved
2	Seye	Scarlet erect	Hybrid scarlet × yellow and pure erect
2	yRye	Yellow recurved	Pure yellow and hybrid recurved × erect
4	SRye	Scarlet recurved	Hybrid scarlet × yellow and hybrid recurved × erect

An examination of the preceding table, in which are grouped the sixteen possible combinations when two allelomorphic pairs are concerned in the hybridization will show that among these sixteen there are nine groups with different germinal constitutions. The visual character of the hybrid plants of these nine different groups is given in the third column and is easily understood by examining the germinal constitution and remembering that scarlet S, and reversed R, are the dominant characters in the two allelomorphs and that the presence of one determiner of either of these characters will cause the appearance of that character in the hybrid plant. It will be observed that by grouping the hybrid plants according to the characters they show, there will be nine scarlet and reversed, three scarlet and erect, three yellow and reversed, and one yellow and erect. This is the Mendelian formula: 9:3:3:1. The nature of the nine different groups of hybrid plants with different germinal constitution is given in the fourth column of the table. When a character is pure, it may be expected to reproduce true in succeeding generations but in those cases in which both determiners of a character-pair are present, the character is of hybrid nature and will segregate in succeeding generations.

In the illustration of the character-pair, scarlet and yellow fruits and the probable ratio of number of unions in F_2 hybrids, it was shown that out of 100 unions one should expect 25 SS:50 Sy:25 yy. If now the second character-pair recurved and erect fruits is con-

sidered in connection with these same 100 unions, there would occur the following combinations, according to the law of chance:

25 SS	50 Sy	25 yy
6¼ SRSR	12½ SRyR	6¼ yRyR
12½ SRSe	25 SRye	12½ yRye
6¼ SeSe	12½ Seye	6¼ yeye

These nine combinations are the same as given above, but the percentage of each combination out of the 100 unions is shown.

If a third character were considered, the proportions of the combinations can be determined in exactly the same way. Each one of the above nine possible combinations would be again divided into three different unions in the same way as the three combinations of the one character-pair gave nine different combinations with the second character-pair. In the consideration of the three character-pairs, there would thus be twenty-seven different combinations of parental characters. And again in each ovary fecundated, when only one determiner of each character-pair occurred, the opposing character-determiner being in each case eliminated, such a cell should give a plant that would reproduce its character true to type. It is well known that almost any two different races or species that may be chosen for hybridization will ordinarily differ from each other in numerous characters. When there are a

647. Pepper hybrids distinct from parental types, formed by recombination of characters; *a*, dwarf type with few small horizontal branches; *b*, giant type with many large erect branches.

number of these opposing characters which form Mendelian character-pairs, the determination of the possible combinations by Mendel's formulæ becomes very complex and difficult to understand. It is only by taking a few well-marked character-pairs and carefully studying them that the segregation and new combinations according to Mendelian proportions can be followed and understood.

Any character-pairs following Mendel's law would segregate as indicated above, in the case of scarlet and yellow fruits and reversed or erect fruits of the pepper. A very large number of characters of various plants and animals are now known to be Mendelian and while many modifications of the principles have been necessary to harmonize them with special cases, still it may be said that there is no other general law of heredity and Mendel's law has thus furnished us with a working basis of great value.

The study of hybrids has been resolved into a study of unit-characters and their relation to each other. By hybridizing related types having opposed characters and observing the segregations which occur in the later generations, the characters of each type are analyzed and it is determined when a character-pair occurs. The researches on this subject by Mendel, Bateson, Davenport, Castle, Punnett, Shull, Hurst, Correns, Tschermak, East and dozens of other now well-known investigators, have developed a science of heredity of which there was no conception a few years ago.

The characters presented by the different varieties of a plant or of different species, which can be crossed with it, can now be studied, and one can definitely plan the combination of characters desired in an ideal type, and can with considerable confidence estimate the number of plants it will be necessary to grow to get this combination. It is now known in general how characters behave in segregation and inheritance, so that one can go about the fixation of a desired type, when one is secured, in an orderly and intelligent way.

The further the study of characters is carried, the more it is coming to be realized that the appearance of apparently new types following hybridization is due to recombinations of different units which in their reactions give apparently new characters. As an illustration, in a study of pepper hybrids, which has been conducted during the past four years, it has become evident that the form of plant and branching is due to three pairs of characters or allelomorphs; namely, first, erect or horizontal branches; second, large or small branches; and third, many or few branches. In crossing two medium-sized races, one with large horizontal and few branches, and the other with small erect and numerous branches, there result many new combinations of characters, among which appear some with small horizontal and few branches, which gives a dwarf plant, and others will have a combination of large erect and numerous branches, which gives a giant plant (Fig. 647). These dwarfs on the one hand and giants on the other appear as distinct, new creations, though they are very evidently merely the recombinations of already existing unit characters, and dwarfness and giantness are the results of the reaction of the different units combined.

When the large number of distinct characters that are presented by the very numerous varieties of any of our cultivated plants is remembered, an understanding is secured of the possibilities of improvement which the field of hybridization affords.

The development of hybrids into pure races.

When hybrids have been produced between species or varieties possessing certain characters that it is desired to unite in a variety, the recombinations of characters as explained in the preceding section become visible in the second generation, and it is thus among the plants of this generation of the hybrid that one should expect to find the combination of characters desired. The breeder would thus very carefully examine a large number of second-generation plants and choose for further experimentation those plants that were found to have inherited the characters which he desired to combine. The entire batch of F_2 plants should be carefully examined to determine what characters behave as character-pairs and also the dominant or recessive nature of each character. This knowledge is necessary in order to determine the practice to be pursued in choosing plants in which the characters desired will be pure with reference to these characters. If, for example, the breeder is working to get a combination of two characters only, such for instance as a yellow- and erect-fruited pepper, from the combination of character-pairs discussed above in explaining Mendel's law he would discover that both of these characters are recessive, and thus when a hybrid was found in which these two characters were united, he could be sure that by self-fertilizing such an individual it would reproduce true with reference to both of these characters in the next and succeeding generations. He would know furthermore in dealing with only two pairs of characters that he should, according to the law of chance, secure on an average about one such combination in sixteen hybrids.

If, however, the combination desired was a scarlet reversed fruit, both dominant characters, the process would be much more difficult. As shown in the preceding section describing the segregation and recombination of characters, nine plants out of the sixteen possible combinations would have red, reversed fruits, while only one of the nine would be pure with reference to both of these characters. The breeder would thus be compelled to self-fertilize a number of the plants having red and reversed fruits and grow a number of plants from each in order to determine which one, if any, was pure with reference to both characters. If, then, the progeny from any one of the plants chosen and self-fertilized came true to type with reference to both characters, he would be certain of its purity and would again self-fertilize some of the best plants of this progeny, which should give him a pure type.

If a combination of a dominant and recessive character is desired, the examination of the F_2 hybrids would enable the breeder to choose a pure plant so far as the recessive character is concerned, but he could not determine the purity of the dominant character and would be compelled to self a number of plants exhibiting the two characters and grow progenies in the third

generation, when he should be able to select a pure type with reference to both characters.

If, as frequently occurs, neither character of an allelomorphic pair is dominant, but gives in the hybrid an intermediate form, the fixation becomes simple, as in such cases those hybrids in which either character is pure can be recognized.

While these methods appear very complex at first, they will be easily understood with careful study, and are far simpler than the methods breeders were compelled to employ in fixing hybrids before they had an understanding of Mendel's law.

When more than two characters are concerned in the recombination, the process becomes more difficult, and indeed one cannot limit one's consideration to two characters in practical breeding unless one is combining standard varieties where all characters are good. As in simple selection work, one must necessarily consider all important characters that go to make up a good variety, and usually one will be able to recognize Mendelian segregation only in a few prominent differential characters. The breeder should use the knowledge of inheritance that he possessess with all characters which he can recognize, but at the same time the plants which he inbreeds to secure purity of type should be perfect plants of all-round good type, and in every generation of the hybrids grown he should exercise his best judgment in selecting the best plants for seed-bearers.

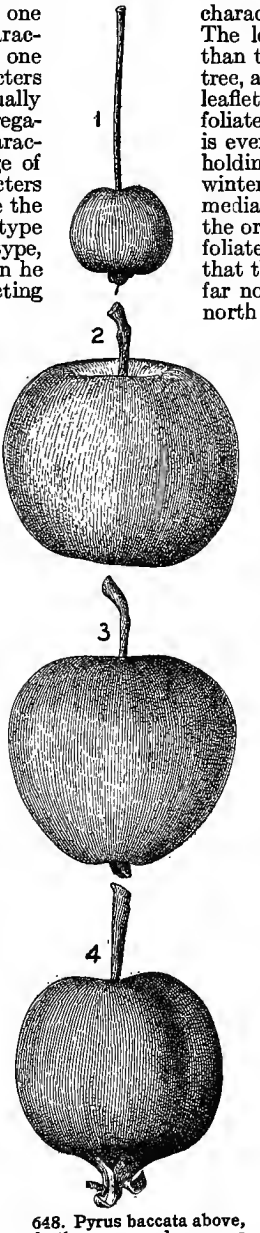
In the fixation of cotton hybrids, the policy was pursued of selecting for inbreeding the most fruitful and best-shaped plants of those hybrids having the desired characters, using very large numbers of hybrids from which to choose. The self-fertilized seed of a certain type was then planted by the plant-to-row selection method in an isolated plat, in order to give an opportunity to select not only the pure combination of the desired characters but the best all-round plants. As soon as the plants in such an isolated plat were sufficiently developed to show their characters and it could be recognized that certain ones had inherited the desired qualities, the fields were carefully searched and all plants not true to type were pulled up, leaving only a few good plants of the correct type. This process of roguing, as the seedsmen call it, insures that at least the greater part of the seed developed would be fertilized with pollen of similar plants of good type. This sort of selection and purification of type will probably in most cases be found necessary even after such Mendelian characters as can be recognized have been secured in a pure state.

The inheritance of many fundamental characters will doubtless remain obscure for many years.

The use of impure first-generation hybrids.

In the case of very many of the most important horticultural crops, fortunately, it is possible to use hybrids without the necessity of purifying or fixing them as described in the last section. Plants such as apples, pears, oranges, grapes, roses and strawberries, which are grown as clonal varieties, being propagated by buds, grafts or slips, are merely parts of one individual and it does not matter whether they are germinally pure, as seeds are not needed. This makes it possible to use F_1 hybrids and, as hybrids are notoriously vigorous, this is a factor of very great importance. Again, characters which blend and give intermediates in the F_1 generation may, in such cases, prove very valuable.

The work that has been carried out by the Department of Agriculture in the breeding of citrus fruits very clearly indicates that valuable intermediates may sometimes be secured. The writer, in conjunction with Walter T. Swingle, hybridized the hardy cold-resistant trifoliate orange (*Poncirus trifoliata*) with several varieties of the tender sweet orange, and as a result at least five different varieties of hardy oranges or citranges have been produced. These hybrids are nearly intermediate between the two parents, having the characters in the first generation nearly blended. The leaves are trifoliolate, but are much larger than the leaves of the ordinary trifoliate orange tree, and show a tendency to drop off, the lateral leaflets producing an unifoliolate leaf. The trifoliate orange is deciduous, while the sweet orange is evergreen. The hybrids are semi-deciduous, holding a large share of their leaves through the winter In hardiness they also seem to be intermediate, being much more cold-resistant than the ordinary orange, but not so hardy as the trifoliate orange. They are sufficiently hardy so that they doubtless may be grown with safety as far north as South Carolina, or 300 to 400 miles north of the present orange region. Some of the fruits produced are as large as the ordinary orange, but most of them are very nearly intermediate in size. They are very variable, however, in the first generation. At least five of the fruits that have been produced are juicy and valuable. It is not probable that they would be reproduced true to seed, but orange varieties are clons, and the different types will, of course, be normally reproduced by buds or grafts, so that from a practical standpoint it does not matter whether or not they would reproduce true through the seed. In the second generation it is probable that these different characters would split up, possibly according to Mendel's law, and it is likely that still more valuable varieties will be secured when a second generation has been grown. See *Citrange*.



648. Pyrus baccata above, and three named crosses with forms of P Malus,—Alberta, Columbia and Robin respectively from top to bottom. (×¾)

Similar groups of valuable intermediate types of fruits have been produced by Wm. Saunders, until recently the Director of the Canadian Experimental Farms, by crossing varieties of the ordinary apple, such as the Pewaukee and Wealthy, with a very hardy cold-resistant crab (*Pyrus baccata*). Saunders has produced already numerous hardy intermediate types which bid fair to be of very great economic value, particularly in the cold regions of Manitoba and Saskatchewan (Fig. 648). Second generation seedlings of these valuable types may be expected to yield still more important improvements.

The reproduction of such unfixed hybrids may be said to form the basis of fruit-culture, as all of the apple, peach, pear, plum, orange, lemon and grape varieties, as well as the varieties of small fruits, are of mixed parentage and do not reproduce true to seed. Most of the varieties of these fruits are either known to be hybrids or are superior seedlings that have been selected and propagated. These latter, doubtless, in the

greater number of cases were of hybrid nature as all of these fruits are normally cross-fertilized and natural hybridization is exceedingly common.

The same may be said of most flowers, such as carnations and roses, that are cultivated extensively for the cut-flower trade. Practically all of the varieties are unfixed hybrids.

The selection of bud-variations.

No consideration of the methods of plant-breeding would be complete without a mention of the improvements that can be produced by what may be termed the selection of bud-variations. While, in general, all buds of a plant are practically the same, as is shown by the fact that buds taken from the Baldwin apple almost uniformly produce Baldwin apples, yet there is considerable variation frequently in the product from different buds, and it is evident that bud-variations may be classified like seedling-variations, into fluctuations and mutations or the so-called bud-sports (Fig. 649). Hybrid plants also frequently, for some cause, show segregations of characters in different buds similar to the segregations shown in F_2 hybrid seedlings. It would thus seem natural to suppose that these variations could be utilized in producing new varieties much as the similar types of seedling-variations are used.

649. Bud sport of Cupressus to fastigiate type, with branch of similar fastigiate variety on right.

In violets, for example, the propagation is normally by slips that are developed from different buds. These slips when grown into plants frequently show considerable difference, and B. T. Galloway and P. H. Dorsett, of the national Department of Agriculture, have demonstrated that by the selection of slips from plants which are very productive the yield in the number of flowers to the plant can be increased considerably. In the case of the orange, seedling trees are almost always very thorny, yet certain branches may show a tendency to be more nearly thornless, and by the selection of buds from such branches the thorny character of almost all the standard varieties has been reduced. By the systematic selection of vegetative parts, such as buds, slips, suckers, and the like, in many cases very important improvements could doubtless be secured, and the plant-breeder should have a thorough understanding of this method of improvement. In hybrids of mixed parentage, frequently a bud on one side of a plant will sport, showing different tendencies, and many of our new varieties of roses, chrysanthemums and carnations have been produced by the selection of such bud-sports. Many standard varieties of carnations have produced bud-variations that have proved valuable; the Lawson has given rise to the Red Lawson and White Lawson; the Enchantress has produced the Pink Enchantress and White Enchantress. The practice of exercising care in choice of chrysanthemum or carnation cuttings and of cions for fruit trees is, therefore, seen to rest on rational reasons.

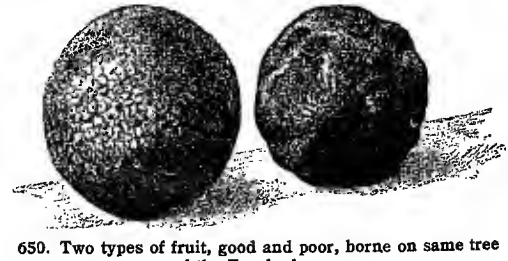
Variations in the character of the seed from different bolls, in the case of hybrid cottons, are frequently found and may be of value to the breeder even in cotton that is propagated by seed. In the study of cotton, similar bud-variations have been found, showing in the lint characters of hybrids. In a number of instances, certain bolls have been found which produced much longer lint than other bolls on the same plant, and similar variations in strength and uniformity of length have been observed. Experiments indicate that such variations, which are doubtless to be classed as bud-variations, are inherited in considerable degree. This being the case even in seed-propagated plants, it becomes desirable to observe and search for bud-variations.

The importance of bud-selection in oranges and lemons has recently been called to attention by the investigations of A. D. Shamel, of the United States Department of Agriculture. It has been found that groves planted with the Bahia or Washington Navel, which is grown extensively in California, frequently show a number of different types with reference to productiveness and form of fruit and that these conditions remain the same from year to year. The same has been found to be the case also in lemon groves, several distinct types not infrequently being produced on the same tree (Fig. 650). These barren trees, and trees producing poor fruit, greatly reduce the production of the grove and in many cases are a serious handicap. Evidence has been collected showing that when buds are taken from productive trees of good type they may ordinarily be expected to produce good types.

In experiments which have been conducted during the last six years in the selection of potatoes, it has been clearly demonstrated that, in a family of potatoes developed from a single tuber and thus positively known to be pure, low- and high-yielding strains can be produced by selecting from low- and high-yielding hills (Fig. 651). Such low- and high-yielding strains have now maintained themselves for three years in over thirty different cases representing work with eighteen different varieties.

The importance of bud-selection is only beginning to be realized and further data is necessary before it can be determined how important this is in different cases. The evidence now at hand, however, clearly indicates that this method of improving plants should be given careful consideration. H. J. WEBBER.

BREVOÒRTIA (J. Carson Breevoort, naturalist, Regent N. Y. State University). *Liliàceæ*. Differs from Brodiæa in the long-tubular and 6-saccate corolla: stamens 3, with 3 broad and truncate staminodia: caps. stalked.—One species.

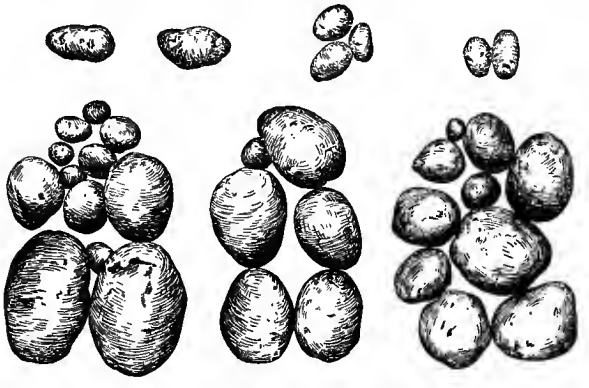


650. Two types of fruit, good and poor, borne on same tree of the Eureka lemon.

Ida-Màia, Wood (*B. coccínea,* Wats. *Brodiæa coccínea,* Gray). FLORAL FIRE-CRACKER. Lvs. slender, grassy: scapes slender, 1–3 ft. high, with 3–6 pendulous tubular-saccate fls. 1–2 in. long, which are brilliant crimson-red, tipped with pea-green. N. Calif. to Ore. in wooded foothills. B.M. 5857. G.C. III. 20:687. Gn. 46, p. 503.—The fls. are very lasting and beautiful.

Half-hardy. Needs partial shade and a deep, loose soil, thoroughly drained, and with some leaf-mold. Corm the size of a nutmeg. CARL PURDY.

BREWÈRIA (Samuel Brewer was an English botanist of 18th century). *Convolvulàceæ*. Perennial herbs, rarely somewhat woody: fls. much like those of Convolvulus but the styles distinct or partly so, the corolla



651. Low- and high-yielding strains of Rural New Yorker potato developed by hill-selection within the progeny of a single tuber.

pubescent outside in the bud: lvs. simple, entire.—Trailing plants of 30 or more species in warm climates.

grandiflòra, Gray. Root tuberous: st. pubescent: lvs. broad-ovate or oblong-ovate and very short-stalked: peduncles 1-fld.; fl. very large (3 in. long), bright blue and showy, funnel-shaped: caps. large and globose-ovoid or ovoid. Fla.—Intro. by Reasoner Bros. One species of Breweria (*B. Pickeringii*, Gray) occurs from N. J. and Ill. south, and a few other species are also native farther south in the U. S. N. TAYLOR.†

BREŸNIA (for J. P. Breyn, a German botanist of 17th century). *Euphorbiàceæ*. Tropical shrubs or trees, rarely cult. Lvs. alternate, simple: fls. small, in short axillary clusters, monœcious, apetalous; calyx imbricate; styles 2-parted: fr. a red berry. Related to Phyllanthus: about 15 species in Trop. Asia and Pacific Isls. *B. turbinàta* (*Phyllanthus turbinatus*, Sims). B.M. 1862. L.B.C. 8:731, may be the same as *Andrachne fruticosa*. J. B. S. NORTON.

BRICKÉLLIA (Dr. John Brickell, an early American naturalist). *Coleosanthus*, Cass. *Compósitæ*. About 40 species of herbs or small shrubs in the warmer parts of the U. S. and Mex., only one of which seems to be in the trade. Somewhat allied to Eupatorium, from which it differs in having 10-ribbed achenes. Lvs. veiny, either opposite or alternate: fls. white, cream-colored or flesh-colored, small, with pappus either scale-like or somewhat plumose, involucral bracts striate-nerved: achenes striate. Prop. by cuttings under a bell-jar.

grandiflòra, Nutt. TASSEL FLOWER. Nearly glabrous, 2–3 ft., branchy above: lvs. triangular-cordate or triangular-lanceolate above, coarsely toothed: heads about 40-fld., drooping, in large panicles, tassel-shaped and yellowish white. Rocky Mts.—Recommended for moist shady borders, and best grown in a mixture of leaf-mold, loam and sand. N. TAYLOR.†

BRIDAL WREATH: *Spiræa prunifolia*.

BRIER. In America, commonly applied to brambles or thorny plants of the genus Rubus, especially blackberries. In the Old World, it is applied to large wild-growing roses.

BRITISH NORTH AMERICA, Horticulture in. The vast territory of British North America, as understood in this article, comprises the Colony of Newfoundland and the Dominion of Canada. Much of the territory is so little developed horticulturally, and most of the provinces are so very large, that rather extended attention is given here to the adaptabilities of the different political divisions. The map (Fig. 652, page 560) shows the outlines of the territory under consideration, and its relation to the northernmost part of the U. S.

Horticulture in Newfoundland has so far not developed to a great extent and the island is not thought of as a horticultural region; but the colony has great possibilities in this direction. The winter temperatures are not so low as in some parts of Canada where apple trees grow well; and with care and protection from wind the hardiest summer and autumn varieties can be grown. The Canada plum (*Prunus nigra*) is a native of the southern part of the island and no doubt good varieties of this could be produced. The European or domestic plums can also be grown successfully near the coast where protected from the high winds, but owing to the moist air they are very liable to become covered with moss and lichens. Bush-fruits thrive, and strawberries and gooseberries succeed particularly well, and English varieties of both these fruits, which do so poorly in Canada on account of the hot, dry summers, are giving admirable results. In winter the plants are well protected by a deep covering of snow. The hardier vegetables flourish, and large quantities of potatoes are grown by the settlers.

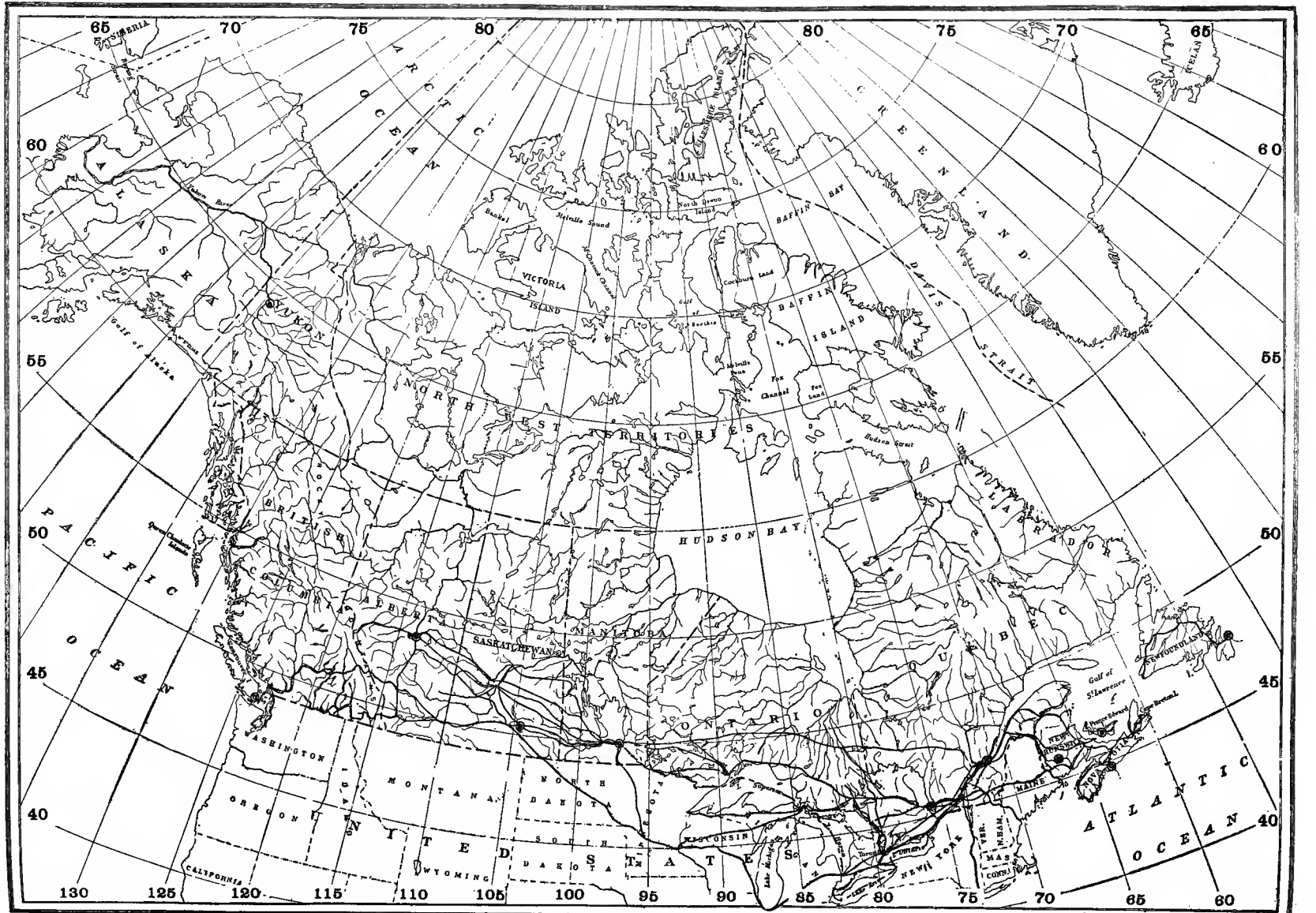
Owing to the relatively moist summer, annuals and herbaceous perennials do particularly well, it being possible to have almost or quite as beautiful a garden there as in eastern Canada.

In the Dominion of Canada, horticulture has become one of the most important industries. In fruit-growing, in floriculture, in vegetable-culture and in the beautifying of cities, towns, and private grounds, Canadians are fully alive to the possibilities of their country; and the rapid development of horticulture in all its branches is an indication of the success that has attended those engaged in its pursuits.

The history of horticulture in Canada dates from the early settlement at Annapolis Royal in Acadia, now Nova Scotia, in 1605, and from the founding of the city of Quebec, now in the province of Quebec, in 1608. There is a definite statement as early as 1663 that apple trees were growing near the banks of some of the rivers in Acadia. There are also records of trees growing in the province of Quebec about that time. In the province of Ontario, it was about the beginning of the eighteenth century before horticulture began appreciably to develop, while in British Columbia, which has made such rapid advances in recent years, fruit trees were not planted until about the middle of the nineteenth century. Owing to inadequate means of transportation, the development of fruit-culture was not rapid in any part of Canada until within the past half-century, but now the extension of orchards, small fruit-plantations, glasshouses, and truck-farms is very marked every year.

The census of Canada for 1911 gives the following figures: Total number of fruit trees in Canada, 20,812,556; area occupied by fruit trees in Canada, 376,322 acres; estimated capital value of fruit trees in Canada, $127,000,000. The quantity of fruit grown in Canada is not known, but the Trade and Navigation Returns for the year ending March 31, 1912, show the exports of fruit from all ports to be:

	Value
Dried apples, 3,149,620 pounds	$248,035
Fresh apples, 1,664,165 barrels	5,104,107
Berries	106,486
All other fruits	159,293
Canned and preserved fruits	257,590



652. British North America, showing Newfoundland, the nine Canadian provinces, and the vast territory beyond.

The larger proportion of this fruit is produced in the provinces of Ontario and Nova Scotia, but rapidly increasing quantities are grown in British Columbia.

The fruit areas of Canada are large enough to supply Canada and a large part of the world with some kinds of fruit, and particularly with the apple, for many years to come. In the great province of Ontario, 220,000 square miles in area, larger than the states of New York, Ohio, Illinois and Michigan together, there are large districts in which apples, pears, peaches, plums, cherries, grapes and the small fruits can be grown to perfection. The province of Quebec is considerably larger than Ontario, and while the tender fruits do not succeed except in the most favored parts, apples are grown in large quantities yearly. From east to west in the provinces of Quebec and Ontario there is a belt of about 700 miles in length in which apples and other hardy fruits can be grown; while in the province of Ontario alone the best winter apples, pears, and plums can be grown successfully over an area about 350 miles long and 30 to 150 miles in width. The successful cultivation of peaches in Ontario is confined to the Niagara district and to points along Lake Erie and Lake Huron, but the area suitable for this fruit is extensive enough to supply a large population.

Nova Scotia has long been noted for its apples. The most favored districts are the Annapolis and Cornwallis valleys, where apples, pears, plums and cherries can be grown and where even peaches can be successfully raised. These valleys have a total length of about 100 miles and vary in width from 6 to 11 miles. Fruit-culture is not confined to this district, as over most of the province the hardier fruits can be grown successfully. New Brunswick has not yet developed a fruit industry to any great extent, but in some of the valleys apples and other hardy fruits of the finest appearance and best quality can be produced. In recent years there has been a marked awakening in this province and, owing to the cheapness of land and the beauty and quality of the fruits that can be produced, there would seem to be a good future for horticulture.

Prince Edward Island, the smallest province of the Dominion, produces excellent tree fruits, and, owing to the late season, the apples keep better than in any other part of the Dominion. Means of transportation are not yet good, but it is hoped that this will soon be much improved.

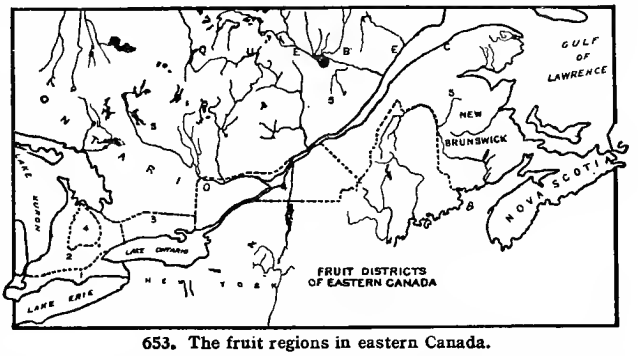
British Columbia, the area of which is about 370,000 square miles, or more than twice the size of California, has large sections admirably adapted to fruits. Like the states of Oregon and Washington, with which its natural conditions may be compared, British Columbia has a number of districts with special conditions. Three of these are, (1) that in the damp coast climate of Vancouver Island and the Lower Mainland; (2) in the dry interior country where irrigation is, as a rule, necessary; (3) in the Kootenays, east and west, where irrigation is necessary only in places. In these districts all the best fruits, including peaches in some places, can be grown to great advantage. There are, however, many valleys that are being found suitable for fruit-culture, varying much in climate and extending from the American boundary far north.

British Columbia is expending its efforts mainly to supplying the prairie provinces of Canada; and it has been very successful in placing fruits on these markets in good condition. The trade abroad is growing also. Ontario is a close competitor of British Columbia for the prairie trade, but the increase in population is so rapid that it will require both provinces to supply the demands for a long time to come.

The prairie provinces of Manitoba, Saskatchewan and Alberta and the great territories to the north produce excellent bush fruits, but the tree fruits have for the most part not done well up to the present, although the hardiest varieties of apples succeed in some of the more favored localities and plums are native to Manitoba and the early varieties can be grown successfully over a wide area.

Some of the influences affecting Canadian horticulture may be mentioned. The Dominion Experimental Farms, now sixteen in number, work upon which was begun twenty-five years ago, have played an important part. There are six Provincial Agricultural Colleges, all of which have Experiment Stations that disseminate information both through the students and by literature. The Provincial Experiment Stations and demonstration orchards are also doing much to explain the possibilities of fruit-culture in their several districts. Seven Provincial Fruit Growers' Associations lend their aid in spreading a knowledge of the best methods of fruit-culture and of uniting the growers in coöperation and legislation. The horticultural periodical literature of Canada, although represented by few papers, has done much to aid fruit-, flower- and vegetable-growers.

The Farmers' Institute and orchard meetings organized by the Provincial Governments and assisted by the Dominion Government, are very practical and helpful. In the province of Ontario, a large proportion of the



653. The fruit regions in eastern Canada.

counties have the District Representative, a Government official whose duty it is to instruct the people by word, by experiment and by demonstration.

The horticultural societies assisted by the Provincial Government, of which there are seventy-five in Ontario, are doing excellent work in awakening a greater interest in horticulture and in spreading information, especially in regard to ornamental plants.

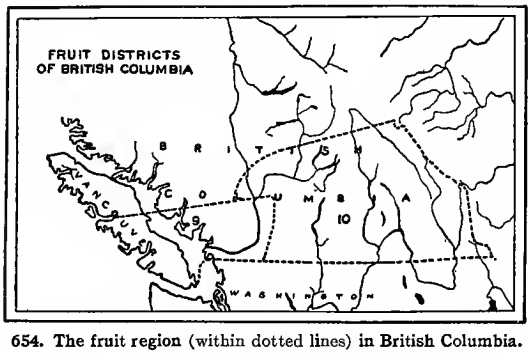
The apples originated by Wm. Saunders in crossing the wild Siberian crab-apple, *Pyrus baccata*, and the varieties of the apple, have enabled the settlers in the prairie provinces to grow at least small apples where larger ones do not succeed; and the larger-fruited varieties obtained by Saunders, by introducing more of the blood of the apple into the first crosses, are now being tested for hardiness, and, if found worthy, will mark a step in advance.

All these factors affecting horticultural conditions and progress have been made still more effective by the coöperative movement that has in recent years made much progress in Canada. In the provinces of Ontario and Nova Scotia are many coöperative associations that now have central organizations where plans affecting the welfare of all the associations are discussed. These associations are doing much to make the fruit marketed of more uniform character and to bring better returns to the producer. One of the best influences in the improvement of horticultural products in Canada is the Fruit Marks Act (now the Inspection and Sales Act) passed in 1901, and operative over the whole of Canada. By this Act, growers are compelled to pack

their fruit according to certain standards and are liable to fine if they do not do so. Inspectors are stationed at packing-houses, on the markets, and at the ports of export, who examine the fruit to determine whether it is packed according to law. A marked improvement has been noticed in the Canadian fruit exported since this law went into effect. There are also standard barrels, boxes and baskets for the whole of Canada.

While floriculture is growing very rapidly, the area under glass in Canada is not very large yet, it being estimated at about 120 acres or 6,000,000 square feet in 1912. The estimated capital invested is $1,500,000 and the value of the output $1,800,000. The flowers most grown under glass in Canada are carnations and roses, although many other kinds are also raised. Some of the Canadian growers have an international reputation for the quality of the flowers they produce. The official organ of the florists in Canada is "The Canadian Florist," a trade paper published every two weeks.

Many kinds of vegetables succeed admirably in Canada and there are a large number of skillful growers. Owing to the rapid development of the larger cities and the many new towns in the newly settled parts, there are many openings for market-gardeners. Large quantities of vegetables, including particularly tomatoes and corn, are grown for the canning factories in southwestern Ontario where the season is earlier than in any other part of eastern Canada. Early vegetables are



654. The fruit region (within dotted lines) in British Columbia.

grown on a large scale, and have proved very profitable to those engaged in the business. Perhaps the most noted vegetable grown in Canada is the Montreal muskmelon, which is well known for its high quality in many cities of the United States. The production of such a high-class melon is a good indication of the summer climate of Canada, which in many parts is hot enough to mature melons well. The market-gardeners are represented in Ontario by the Provincial Vegetable Growers' Association, branches of which are to be found in a number of the cities and towns. This organization has done much to assist market-gardeners and to make them feel that their calling is as important as any other branch of agriculture. W. T. Macoun.

Nova Scotia.

Nova Scotia (Fig. 655) is a peninsula on the extreme eastern side of Canada. It extends in a northeasterly and southwesterly direction and is crossed by the forty-fifth parallel of north latitude. No part of the interior is more than 30 miles from the sea. The surface is gently undulating, with no high mountain ranges. The principal farming and fruit-growing sections are mainly in the valleys through which the rivers run and around the headwaters of the Bay of Fundy, where the high tides have left extensive deposits of rich alluvial soil. The annual rainfall is about 42 inches.

The French Acadians early made plantings of the apple in this province. When the New England settlers came, in 1761, to occupy the lands of the deported French, they found apple trees in bearing, many of which lived and continued to bear fruit well along into the last century. The leading horticultural industry is fruit-growing. Its most important division is apple-culture, although pears, plums, cherries and small fruits are successfully grown. These soft fruits are necessarily sold in the local markets, which, though steadily growing in size, are as yet of too limited capacity to justify an extensive development of the culture of such perishable products. Apples, on the other hand, are shipped to the British and other foreign markets where, in their season, they successfully compete with those from other parts of the northern hemisphere.

The strictly horticultural region of Nova Scotia is a small section of the western part of the province generally called the Annapolis Valley. This region, except in its extreme eastern part, is separated from the Bay of Fundy and protected from the direct force of the northerly and westerly winds by a range of hills, some 400 to 500 feet in height, known as the North Mountain. It includes the valley of the Annapolis River, which flows southwesterly to the Annapolis Basin, and the valleys of the Pereaux, Habitant, Canard, Cornwallis, Gaspereau and Avon Rivers, which flow into Minas Basin on the east. It is a narrow strip of country 6 to 10 miles wide and less than 100 miles long.

Here apple-culture, from being a side line to general farming down to about forty years ago, has grown to be the leading branch of agriculture. The yield of apples in this district, packed and sold in 1911, was 1,734,000 barrels. The yield for 1912 is estimated at 1,100,000 barrels. These figures do not include, in either case, those that were used by the canneries, evaporators and vinegar factories, or that were consumed in the district in which grown. About one-tenth of the output finds a market in the towns and the villages of the non-fruit-growing sections of the maritime provinces, the remainder being exported to Great Britain, Germany and other European countries, and to Newfoundland, the Canadian West, the West Indies and South Africa. The varieties of apples grown have been selected chiefly with reference to the English market. The leading commercial sorts are Gravenstein, Blenheim, Ribston, King, Yellow Bellflower, Cox Orange, Wagener, Baldwin, Stark, Spy, Golden Russet, Fallawater, Roxbury Russet and Ben Davis. Some of these have long been known in England and were introduced from that country. The Gravenstein, especially, reaches a high quality here. The winter varieties also do well and mature just as the cool weather of autumn comes on.

As a rule, orchards are carefully cultivated, fertilized, pruned and sprayed. A large quantity of commercial fertilizer is used every year, as the area in orchards has outgrown the supply of stable manure. Cover-crops are grown to furnish humus, the clovers, vetches and buckwheat being the crops chiefly used for this purpose. The practice of thinning apples has lately been adopted by many of the best growers and is likely to become more general as competition in fruit-raising increases.

A system of frost-proof apple warehouses, that has come into existence during the last sixteen years, is an important element in the carrying-on of the fruit business in Nova Scotia. These—numbering one hundred in all—are found at the railway stations throughout the fruit district. The usual width is about 40 feet, the length from 80 to 120 feet, affording room for packing and storage for 5,000 to 10,000 barrels. Formerly, the fruit-grower packed his apples at home, or in his barn. Then, when a steamer was ready to load at Halifax, the apples had to be hauled to the railroad station, often several miles distant, and loaded into the waiting cars. Now the apples are generally taken in barrels directly from the orchard to the warehouse where they are stored until ready to be packed out for shipment.

XVIII. Canadian orchard development.—The tidewater country in Nova Scotia.

Under this system, it is possible with very little delay to pack and place on cars a steamer-load of apples. A railway haul of four or five hours brings the cars to the side of the steamer so that the danger from frost, even in zero weather, is largely avoided.

A further advance was made in the business of packing and marketing apples when coöperative fruit companies were formed. The first company of this kind was organized in Berwick in 1907. During the next five years, more than thirty similiar companies were formed. Under provincial legislation enacted in 1912, these were organized into a central association known as the United Fruit Companies of Nova Scotia, Limited. All the apples of the companies affiliated in this central association are sold through its agency. It controls the sale of fully one-half of the apple crop of the province. A uniform standard of grading is maintained, an official of the central association inspecting the packing in all the warehouses of the affiliated companies. Coöperation in the marketing of apples was quickly followed by the coöperative manufacture of barrels and purchase of fertilizers, feeds and seeds, greatly to the convenience and financial advantage of the members of the companies. In the near future, all farmers' supplies will probably be purchased coöperatively.

The establishment of evaporators, canneries and vinegar factories throughout the fruit district, some of them owned by coöperative companies, furnishes a market for defective fruit and has also the effect of improving the grade of apples packed. There are now eight evaporators, two canneries and four vinegar factories in operation.

Local nurseries, chiefly for the propagation of apple trees, are to be found at Annapolis, Berwick, Waterville and Wolfville. While these have received good patronage in the past, the larger quantity of nursery stock in recent years has been imported, chiefly from Ontario. With a view to avoiding the danger of introducing noxious insects and plant diseases, the provincial department of agriculture has lately passed strict regulations governing the importation of nursery stock. The effect of this has been to stimulate the home nursery industry.

Pears, plums and cherries are grown for home use and the local markets. Bartlett and Clapp Favorite are the varieties of pears most largely grown. Moore Arctic, Lombard, Yellow Egg, the Gages, Damsons and Burbank are the chief plums. The cherries are the Morello and other varieties of the sour type. Peaches are grown to some extent in the western part of the province, Alexander, Early Canada and Fitzgerald proving hardy.

Cranberries constitute an important part of the fruit crop of Nova Scotia. They are grown on reclaimed bog lands that would be unsuitable for any other farm crop. There is much land of this kind in the province still unused. In 1908, the cranberry crop in the vicinity of one railway station, Auburn, amounted to nearly 5,000 barrels and netted the growers $25,000. A good market for Nova Scotia berries is found in Montreal and the Canadian West.

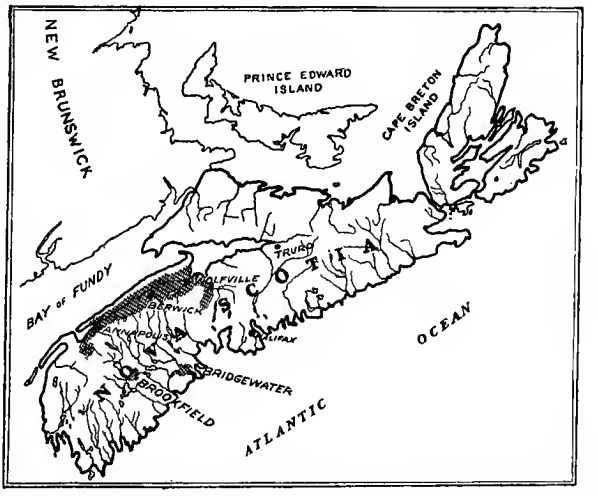
Truck-gardening is conducted to some extent on the light sandy soil of the central part of the Annapolis Valley. In the vicinity of Berwick, Aylesford, and Kingston, such crops as strawberries, raspberries, tomatoes, green beans, asparagus and rhubarb, are grown for the local markets. Some of the tomatoes go to the cannery.

Only one important variety of apple originated in Nova Scotia, the Banks Red, a bud-sport of the Gravenstein. John Burbidge, who settled in the Cornwallis Valley in 1764 introduced the Nonpareil (Roxbury Russet). Charles Inglis, first Bishop of Nova Scotia, who received a grant of land in Aylesford Township, in 1790, introduced the Yellow Bellflower, which thence came to be known here as Bishop Pippin. Charles R. Prescott introduced Ribston in 1814, Blenheim in 1829, Gravenstein and Alexander in 1835, Baldwin and Greening in 1820 and Northern Spy shortly after 1852.

The Nova Scotia Fruit-Growers' Association, founded in 1863, is the oldest in the Dominion, and receives an annual grant from the provincial government. For several years it assisted in maintaining a school of horticulture at Wolfville. In 1905, this school was merged into the College of Agriculture at Truro.

In 1911, a fruit experiment station was established at Kentville. This is maintained by the federal government at Ottawa. The provincial government has established thirty-five demonstration orchards in parts of the province outside the fruit district proper. The purpose of these orchards is to discover the fruit-growing possibilities of the different sections of the province, to find out the varieties best suited to these sections, and to give a demonstration of what orchard practice is considered most effective in such localities. Horticulture is taught at the Agricultural College which was established at Truro in 1905.

PERCY J. SHAW.



655. Nova Scotia, showing the present fruit district and two centers (Bridgewater and Brookfield), where the industry is beginning to develop.

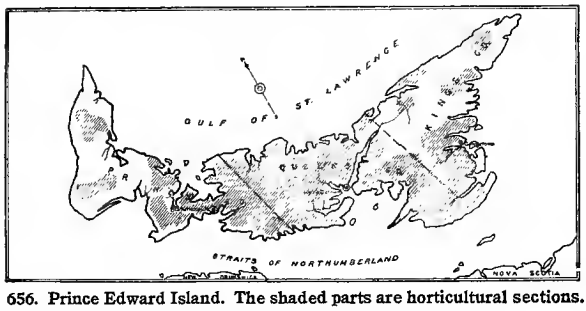
Prince Edward Island.

In the Gulf of St. Lawrence, and separated from the continent by the Northumberland Strait, lies the province of Prince Edward Island (Fig. 656), the "low and beautiful land" that Cartier saw on the afternoon of June 30, 1534. It is situated between 46° and 47° 7′ north latitude and east of 64° 27′ west longitude, and is distant from New Brunswick 9 miles, from Nova Scotia 15 miles and from Cape Breton 30 miles. In form, it is an irregular crescent, concaved toward the north with such an exceedingly indented coastline that no part of the country is far distant from the sea. Sand-dunes extend along the north shore for a distance of 50 miles. The surface is gently undulating. Ranges of low hills traverse the island from New London to Hampton, from Brooklyn to Wood Islands, and from Red Point to Rollo Bay. The highest elevation is less than 300 feet. Small flat areas occur in the western part of Prince Co.

The climate is temperate and not subject to rapid changes. For the past five years, the average temperature during the winter months was 36.6°, the lowest registered being −19.5°, and during the summer months 70°, with 86.5° the highest. The yearly precipitation varies from 38 to 42 inches, a little less than half falling during the months May to October in light showers at more or less regular intervals.

The whole population is engaged in agriculture and fishing and in the merchandise connected therewith. Horticulture is yet in its infancy and only very few of the inhabitants have begun to realize its possibilities.

Nearly every farmer has a few trees producing sufficient apples for his own family. But few have seriously



656. Prince Edward Island. The shaded parts are horticultural sections.

considered apple-growing as a revenue-producing branch of agriculture. The first trees were planted shortly after the English occupation in 1763. The stock was brought out from the Old Country and was nearly all of the cider varieties. On this account it was generally believed that good apples could not be grown in this province. For over a century very little improvement was made.

The development of the apple industry in Nova Scotia stimulated the planting of more trees in Prince Edward Island and led to the setting out of nurseries in 1886 by William Taylor at Lower Freetown and by Condon at Kensington. They received a great many orders for trees but the orders were so small (very few people wanting more than half a dozen) that there was not much profit in the business and it was not continued.

A few men, however, were enthusiastic over the possibilities of fruit-growing and at the call of Lieutenant-Governor Howlan met in Charlottetown on March 30, 1896, and formed the Fruit-Growers' Association of Prince Edward Island. It received the encouragement of the Department of Agriculture and was given an annual grant of $100, for the purpose of holding a fruit show.

This again gave a further stimulus to tree-planting, and nurseries were set out by D. A. Sharp at Summerside, Thomas Moyse at Central Bedeque and John Robertson at New Perth. Many trees were sold but the business does not seem to have been very profitable, and at the present time all the stock is imported. A few men, however, set out commercial orchards and between the years 1897 to 1900 some shipments of apples were made to the British market. It was very difficult, however, to find more than a few barrels of one variety in a district. This added very much to the expense of packing and shipping, and as the business was at best very uncertain, it was soon given up.

In 1909 the Coöperative Fruit Company was formed. The purpose was to provide proper packages and to get together sufficient quantities of apples of one variety to make a profitable shipment. The Department of Agriculture provides the Company with a secretary and makes a small annual grant, sufficient to cover truckage expenses.

In 1909, eighty-four barrels were shipped; in 1910, some 350 barrels. The expenses of getting their apples together, graded, properly packed and marketed were too great and in 1911 each grower shipped his own. This, however, proved even less satisfactory and the Company is preparing to pack again this autumn. They hope, however, to get a number of barrels of apples together at certain centers, and with this end in view, all the orchards in these vicinities are being sprayed.

For a number of years the question of varieties has been taken up by the Fruit-Growers' Association. The following are now recommended: For home orchard—Yellow Transparent, Crimson Beauty, Duchess of Oldenburg, Wealthy, Wagener, King, Northern Spy, McIntosh Red, and Stark. For commercial orchard—Wealthy, Alexander or Wolf River, McIntosh Red, Ribston Pippin and Ben Davis.

The feeling is general that the next few years will witness a great development of the apple industry in Prince Edward Island.

Very few pear trees have been planted, but when given good cultivation and properly sprayed, they have done well. The most popular varieties are Clapp Favorite, Bartlett, Vermont Beauty, Flemish Beauty, Howell and Anjou.

The cool, moist climate of Prince Edward Island favors the growing of plums of the very finest quality, and of late years quite a number of trees have been set out. Among the varieties best suited to Island conditions are Glass Seedling, Moore Arctic, Quackenboss, Yellow Egg, Victoria, Bradshaw, Prince Englebert and Blue Damson.

Cherry trees were introduced by the early French settlers and, as they were able to take care of themselves, met with great success. Nearly every farmstead has a few trees. The crop is, however, very uncertain, as a late frost catches the blossoms about every third year. They are nearly all sour cherries of the Richmond and Montmorency varieties. In a few orchards sweet cherries are being tried with indifferent success. They bloom too early and are caught by the frost.

Grass lands that have not been manured with mussel mud invariably grow a crop of strawberries in every part of the province. The increased cost of labor has made the picking of the wild ones unprofitable and for the last few years the cultivated varieties have taken their place on the market. From 8,000 to 10,000 boxes to the acre is considered an average crop. Some progressive farmers have had very large returns from strawberry-growing, with the result that prospects are very bright for a large industry. The chief varieties grown at the present time are Splendid, Glen Mary, Senator Dunlap, Williams and Wilson.

Among the bush fruits, raspberries and blackberries are being cultivated but not to the same extent as gooseberries and currants, which are in greater demand. All, however, are being grown very successfully. Dewberries are not grown to any extent. They have been introduced at the Experimental Farm and their cultivation will likely be extended.

As wild strawberries are found in the higher grasslands, wild cranberries are found in the bog-lands and marshes. In a few districts they are being cultivated and giving very large returns. When the plantation can be flooded, the crop is fairly sure, but when it cannot be flooded the frost frequently does much damage. The average crop is about eighty bushels to the acre.

There are several thousand acres of blueberry barrens in the province, from which about twenty carloads of berries are shipped annually. They do not, however, seem to improve by cultivation and the increasing cost of labor will likely lessen the amount marketed. Now and again the crop is a comparative failure, due to frost or to severe drought.

Prince Edward Island is peculiarly adapted to the growing of fruit. The reason that more progress has not been made is the inadequate transportation facilities. Last year, however, arrangements were made for three calls of an ocean steamship at Charlottetown on the way from Montreal to Manchester. The car ferry, also, that is about to be built between Carleton and Cape Tormentine will further help to overcome this difficulty, and it is expected that the next few years will witness a great development in horticulture in this

province. The census returns for 1911 give the following figures of the industry:

	No.	Product
Apple trees	205,979	160,124 bushels
Peach trees	546	13 bushels
Pear trees	2,439	773 bushels
Plum trees	20,625	27,480 bushels
Cherry trees	53,094	7,576 bushels
Other fruit trees	9,998	1,479 bushels
Grapes		1,641 pounds
Strawberries		186,692 boxes
Currants and gooseberries		48,429 quarts
Other small fruits		1,860 boxes

THEODORE ROSS.

New Brunswick.

The province of New Brunswick (Fig. 657) lies mainly between 45° and 48° north latitude, and 64° and 68° west longitude. Its boundaries are: On the south the Bay of Fundy, on the east the Strait of Northumberland and the Gulf of St. Lawrence, on the north the Bay of Chaleur and the province of Quebec, on the west the state of Maine. The greatest length of the province from north to south is 230 miles, and its greatest breadth is 190 miles. It has an area of 27,985 square miles and about 600 miles of seacoast. It is a rolling country of no great elevations with the more hilly sections formed by an extension of the Appalachian Mountains in the northern and northwestern parts of the province. Few countries are so well watered as New Brunswick. Lakes and small streams are numerous all over the country. The St. John River, which flows into the Bay of Fundy, is 450 miles long. The Miramichi and Restigouche Rivers, both of which are over 200 miles long, drain into the Gulf of St. Lawrence. The Petitcodiac and St. Croix are important rivers situated respectively in the eastern and western ends of the province and flowing into the Bay of Fundy. The yearly record for continuous sunshine is excelled by only one other province in the Dominion. The average hours of sunshine recorded yearly at Fredericton is 1,983. The average annual precipitation for the last thirty-eight years at Fredericton is 45.6 inches.

The province contains 17,393,000 acres, of which 7,750,000 are Crown land, 5,000,000 acres are settlement land and 4,643,000 acres are private timber land. According to the report of the Agricultural Commission, which investigated farming conditions all over the province in 1908, there were at that time 32,480 farms, and 1,474,076 acres of cleared land.

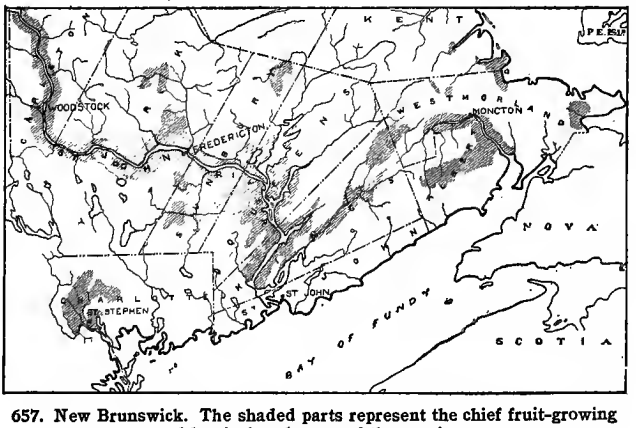
Potato-growing is the leading horticultural industry. The province is particularly adapted for the production of this crop, as the comparatively cool moist climate enables the potatoes to grow for a long period of time, and they are green and vigorous until the frost comes, hence their firmness, full starch content, good keeping quality and pleasant flavor. An additional advantage is the ease and cheapness with which the potato can be shipped to tide-water, since the St. John River and its tributaries water an area of 2,000 square miles. Carried in scows, potatoes are delivered in St. John from York County for 5 cents the barrel. Carleton County on the western border, watered by the upper reaches of the St. John River, has long been the banner county for potato-growing. In 1910, it had 8,786 acres under cultivation, with a production of 1,127,680 bushels, or 128.3 bushels to the acre. In 1909, from 8,940 acres, it derived 1,800,676 bushels, or 201.4 bushels to the acre. The same year the province averaged 187.4 bushels to the acre. Victoria County, to the north of Carleton County and immediately adjoining Aroostook County, Maine, affords considerable excellent potato-raising land. In fact, the entire valley of the St. John River is well suited for this purpose and potatoes are also grown extensively in the eastern counties of Kent and Westmoreland.

The entire acreage under potatoes in the province in 1910 was 47,744 and the yield 6,067,276 bushels. In 1909 it was 47,853 acres and the yield was nearly 9,000,000 bushels. In 1911, the acreage was 47,304 and the yield 8,493,212 bushels. Large quantities of potatoes are now being shipped annually to Ontario, the West Indies and Cuba. Experiments conducted during the past few years by experimental stations and practical farmers in Ontario show that potatoes produced in the maritime provinces gave a much larger yield than those from Ontario-grown seed. This has led to an increasing demand from Ontario for New Brunswick potatoes for seed purposes.

Apples were undoubtedly grown in the province in the early part of the nineteenth century, but it remained for Francis Peabody Sharp, New Brunswick's pioneer horticulturist, to demonstrate the possibilities of commercial apple-growing in this northern climate. His operations were conducted at Upper Woodstock on the St. John River, and there, in 1844, he set out his first trees. Sharp planted many large orchards, did extensive work in hybridizing and introduced many of the standard varieties into New Brunswick from the United States and elsewhere. His death occurred at Upper Woodstock in December, 1903. From that time an impression that apple-growing could not be made a success seemed to gain ground, but of late years this has been swept away and the outlook for the future of the industry is now very bright.

The list of apples recommended for New Brunswick covers the season and provides a class well suited for export shipment, as well as for supplying the local markets. With cheap and rapid transportation by water, with an over-seas market close at hand, with plenty of suitable land at a moderate cost, with the knowledge that has been secured as to the proper varieties to plant, and with the active coöperation of the government, the success of New Brunswick as a fruit-producing area seems assured.

Many commercial orchards are now being planted, chiefly in the St. John River valley and in the eastern part of the province, and apple-growing bids fair in the near future to take first place in the horticultural crops of the province. The provincial Department of Agriculture established a horticultural division in 1910 and there are now a provincial horticulturist and three assistants actively engaged in promoting the fruit-growing industry. Preparations for an export trade are being made by experimental shipments of apples

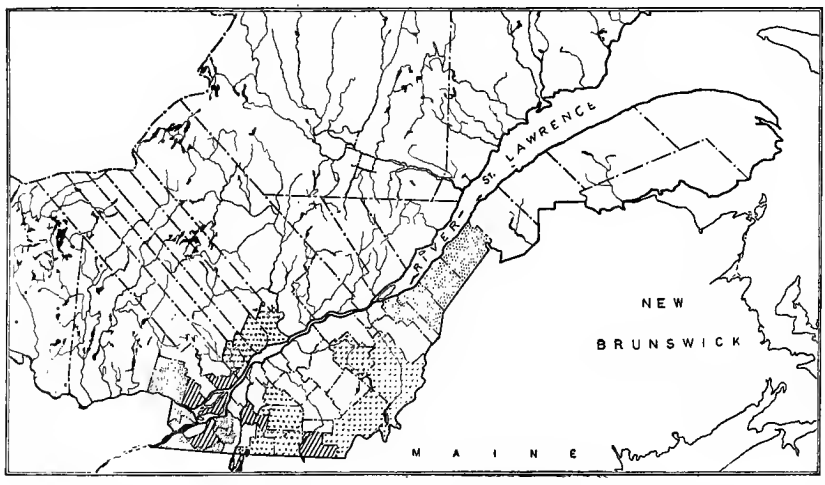


657. New Brunswick. The shaded parts represent the chief fruit-growing and horticultural areas of the province.

to the European markets and the placing of exhibits in the principal cities of the United Kingdom and Canada. The following varieties of apples are grown very successfully: Crimson Beauty, Red Astrachan, Duchess, Sharp New Brunswick, Yellow Transparent, Wealthy, Dudley, Alexander, Wolf River, Fameuse, McIntosh Red, Bishop Pippin, Golden Russet and Bethel. Northern Spy, King of Tompkins and Rhode Island Greening are grown to a limited extent. The Moore Arctic, Lombard and Yellow Egg plums and Flemish Beauty and Clapp's Favorite pears are grown successfully.

Wild raspberries, strawberries, blueberries and cranberries grow in abundance. Strawberry-culture was first introduced into New Brunswick at Kingston, Kings County, about 1862, by the late D. P. Wetmore, Inspector of Schools. Large quantities are now produced, and as the season of maturity is comparatively late, many shipments are made to Boston and Montreal, where they are much in demand, as the strawberry crop is then finished in other sections. Blueberries grow wild in enormous profusion and are canned in large quantities.

Truck-gardening is practised extensively on the



658. Horticultural regions of Old Quebec.

northeastern bank of the St. John River, in the vicinity of Maugerville and Sheffield. The soil there is a dark loam, several feet deep and exceedingly fertile, being the old river-bed, and large quantities of cabbages, cauliflowers, tomatoes, cucumbers, and the like, are grown and shipped to Fredericton and St. John.

A. G. TURNEY.

Quebec.

Old Quebec (Fig. 658) occupies a unique position in the Dominion of Canada because it is the oldest province, the largest province and the province in which the English-speaking people are in the great minority. Although not regarded as maritime, yet it possesses considerable coast; and the mighty St. Lawrence takes on the character of an open sea. The St. Lawrence and the numerous rivers and lakes that feed it are the principal physical features of the province, and these features have made of Montreal, Quebec's chief city, the importing, exporting and distributing center of Canada. The Appalachian Mountains extend into Quebec under the name of Notre Dame, but in no place do they reach any great height. The greater part of the country is decidedly level, while some sections are gently undulating.

South of the St. Lawrence the climate is not severe; but in the extreme north arctic conditions prevail and the country is sparsely inhabited. The greater part of the province, however, is well suited to agriculture, and the returns per acre compare favorably with other agricultural areas of Canada. The rainfall, although quite scanty at certain seasons, is usually sufficient. Irrigation is seldom or never practised and is usually unnecessary.

When horticulture began in Quebec is not known, as it is older than the oldest records. When the country was first explored by the French, the Indians knew the melon and cultivated it with some success, as well as a number of other crops of interest to horticulturists. Father Charlevoir (S.J.), the historian, is very plain on this latter point. In a letter dated Chambly, April 1, 1721, while referring to Montreal, he asserts that "The Indians, before our arrival in Canada, were familiar with both ordinary melons and watermelons." He said, "The former are as good as any in France, especially those raised on the island of Montreal, where they grow in rich profusion" (Vol. III, Journ. d'un Voyage, etc., p. 164).

That melons in ordinary seasons were common enough in Montreal may be gleaned from the appended quotations from a letter of Father Claude Chauchetiere (S.F.), dated Montreal, August 7, 1694: "We have had no melons to speak of this year; we shall barely have enough for seed. This is something I have never yet seen before in Montreal, and every one is surprised at it."

The "Relation par lettres," 1709, attributed to Father Antoine Tiley (S.J.), is authority for the statement, "The savage had the small squash, the watermelon, the gourd and the sunflower before the French came to the country." Although horticulture is old in Quebec, it has never been extensively practised, and the industry is expanding slowly. In the vicinity of Montreal, vegetables are extensively cultivated for the home market, but the home market is not nearly supplied by native-grown produce and will not be for some time to come.

The present fruit areas are indicated on the map by parallel lines, while those partly in fruit are dotted. The areas in which fruit might be grown are inclosed by a dark line surrounding the section. It will be seen that the total area is not large. Much of the province south of the St. Lawrence possesses great horticultural possibilities and expansion may there be looked for. Rouville, Chateauguay, Hochelaga, Jacques Cartier, Two Mountains, Stanstead, L'Assomption are regarded as fruit counties; Huntingdon, Argenteuil, Vaudreuil, Soulange, La Prairie, Napierville, Kamouraska, L'Islet, Montmagny and Bellechasse are partly in fruit; while Compton, Missisquoi, Brome, Beauce, Shefford, Bagot and counties on the St. Lawrence to Champlain County may be regarded as possible fruit areas, but are not as yet extensively planted.

The present status of horticulture may be gleaned by a study of the census of 1911 so far as the fruit industry is concerned. It would seem that many of the old trees have fallen victims to the ravages of time; but that young trees are being set in larger numbers. Better methods and a more thorough dissemination of knowledge are constantly crowding out the old, so that there

is no doubt that a few years hence the number of bearing trees will be much increased. The census figures are as follows:

	1901	1911	Increase or decrease	Per cent of Increase or decrease
Orchard and nursery (acres)	34,289	34,376	Inc. 87	Inc. 0.2
Vineyard (acres)	119	641	Inc. 522	Inc. 438.6
Small fruits (acres)	not given	1,669		
Apple trees (no.)	2,256,752	2,158,589	Dec. 98,163	Dec. 4.3
Bearing (no.)	1,476,727	1,295,992	Dec. 180,735	Dec. 12.2
Non-bearing (no.)	780,025	862,597	Inc. 82,572	Inc. 10.5
Product (bus.)	2,025,113	1,401,109		
Peach trees (no.)	332	2,244	Inc. 1,912	Inc. 575.9
Bearing (no.)	68	1,641	Inc. 1,573	Inc. 2,313.2
Non-bearing (no.)	264	603	Inc. 339	Inc. 128.4
Product (bus.)	17	987		
Pear trees (no.)	11,823	7,534	Dec. 4,289	Dec. 36.2
Bearing (no.)	5,191	3,807	Dec. 1,384	Dec. 26.6
Non-bearing (no.)	6,632	3,727	Dec. 2,905	Dec. 43.8
Product (bus.)	3,275	4,967		
Plum trees (no.)	364,280	260,076	Dec. 104,204	Dec. 28.6
Bearing (no.)	245,370	133,567	Dec. 111,803	Dec. 45.5
Non-bearing (no.)	118,910	126,509	Inc. 7,599	Inc. 6.3
Product (bus.)	122,648	51,045		
Cherry trees(no.)	394,090	167,275	Dec. 226,815	Dec. 57.5
Bearing (no.)	317,762	111,267	Dec. 206,495	Dec. 64.9
Non-bearing (no.)	76,328	56,008	Dec. 20,320	Dec. 26.6
Product (bus.)	150,690	44,705		
Other fruit trees (no.)	28,528	42,687	Inc. 14,159	Inc. 49.6
Bearing (no.)	23,711	33,073	Inc. 9,362	Inc. 39.4
Non-bearing (no.)	4,817	9,614	Inc. 4,797	Inc. 99.5
Product (bus.)	21,386	10,764		
Total fruit trees (no.)	3,055,805	2,638,405	Dec. 417,400	Dec. 13.6
Bearing (no.)	2,068,829	1,579,347	Dec. 489,482	Dec. 23.6
Non-bearing (no.)	986,976	1,059,058	Inc. 72,082	Inc. 7.3
Grapes (lbs.)	995,849	310,826	Dec. 685,023	Dec. 68.7
Strawberries (qts.)		1,955,749		
Currants and Gooseberries (qts.)	842,968	661,101	Dec. 181,867	Dec. 21.5
Other small fruits		194,901		

The nursery business is popular in the province. Considering the size of the horticultural areas, the number of nursery firms doing business is large. Under the name of "northern-grown stock" the sale has been pushed. All nursery produce is carefully inspected by government officials, and all imported stock must be inspected before planting may be made.

Many varieties have originated in Quebec. The most of these are of minor importance, but the Montreal melon and the Fameuse apple have done more to advertise horticulture in Quebec than all other causes combined. The Montreal muskmelon is a melon of great size, often weighing nineteen and a half pounds. There are many cases on record in which they became much heavier, but these exceptionally large ones are not sought after. It has been stated that early French Jesuits brought melon seed to Quebec and that the present Montreal melon evolved from this source, but there is no such record. If this ever happened, the event was deemed of so little importance as to be unworthy of record. There can be no doubt, however, that the Indians were cultivating the melon in Quebec when first explored by the French in 1645 to 1649. Father Bressani (S.F.) mentions a plant he had seen in the country of the Hurons, now Simcoe County, which he says was similar to the melon of India (Bresse Relation, Martin's translation, p. 68). The Journal of a "person of merit," name not given, 1663, who was sent out expressly to report on the resources of Canada, and who spent one year in the colony, has this to say on the matter in question: "Thence we proceeded up the river to Montreal. Its latitude is that of Bordeaux, its climate most agreeable, its soil excellent; a gardener here has but to cast his melon seeds into a little patch of loosened earth among the stones and they do not fail to thrive without further care on the part of the man" (Relations 1663, quib, ed. p. 28, 2 col.; Chiv. ed., Vol. 48, p. 169). He adds, "Squashes are raised there with still less labor, but differ much from ours [in France] for some have the flavor of apples and pears when cooked." The Montreal melon has not been an equal success in other sections. The peculiar soil-formation and climatic conditions on the island of Montreal combine to give the fruit a flavor which is not equaled elsewhere. At the beginning of the melon season moderate-sized specimens bring on the Montreal market $18 per dozen and retail at $2.25 each. The Fameuse apple is now commonly spoken of as the national apple of Quebec. No definite records exist concerning the exact origin of the Fameuse. There can be no doubt, however, that the Fameuse is a seedling arising from seed brought from France by early French priests. The Fameuse in Quebec is a very striking apple; in form, color and flavor it is par excellence. No province to the west can compete with Quebec's Fameuse. Specimens are produced here as nearly ideal as may be found, as comparative exhibitions have shown. Fameuse apples from this province are easy winners.

The local government grants $12,600 as an aid to horticulture. From this sum $7 a month is allowed all students from Quebec attending the regular agricultural courses at the colleges; $1,500 is granted to three pomological societies. Aid is also given to horticultural extension work, such as demonstration trains, demonstration orchards and various forms of institute work. Horticulture is taught in three colleges, Macdonald College, Oka, and St. Anne de la Pocatiere, which deserve special mention. Macdonald College is unique in agricultural development along educational lines. It sprang into being fully equipped and ready for efficient service at once. This was made possible by the munificence of Sir William Macdonald, a public-spirited capitalist of Montreal. It was Macdonald who financed the undertaking; but it was James W. Robertson, a man of great vision, who, by means of lectures, literature and personal persuasion, aroused widespread interest in agriculture; and who, by his work and ideals was able to attract the attention of Sir William and to gain his financial support. The college property comprises 561 acres, and boasts the largest horticultural department in similar institutions in America. The courses run over four years, leading to the degree of B. S. A. The agricultural school conducted by the Trappist fathers is of great interest to visitors. These Trappist monks, by their industry and skill in agriculture, have changed the face of the countryside in the region of the Lake of the Two Mountains since 1880. The scientific and practical training at the college is given by twelve to fifteen fathers and lay teachers. The average number of pupils at present is about one hundred, who come largely from the province of Quebec. Students who have passed all examinations successfully obtain the degree of B. S. A. from Laval University. The agricultural school of St. Anne de la Pocatiere teaches horticulture as well as allied agricultural subjects. A limited number of students are in attendance, who secure diplomas upon completing the courses.

E. M. STRAIGHT.

Ontario.

The horticulture of Ontario is undergoing very rapid evolution. The province is so situated geographically and topographically as to enjoy a climate much milder than that of most parts of Canada. Within the prov-

ince, towns and cities are growing very rapidly, and markets are thus being provided for high-class products of all kinds. The Canadian Northwest, also, is rapidly becoming an important market and is attracting every year a large volume of trade that formerly went to Great Britain and western Europe.

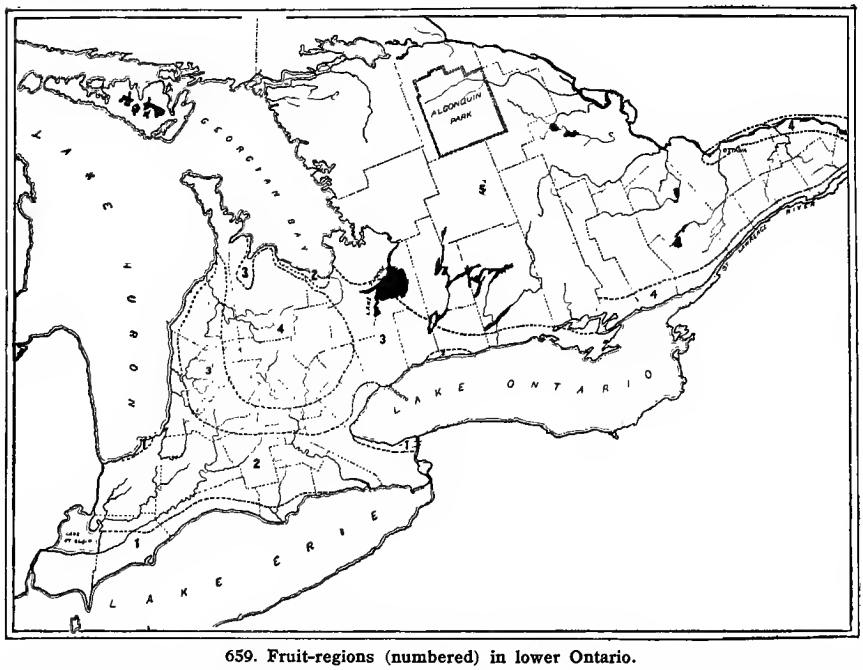
Ontario (Fig. 659) includes a vast extent of country, being over 700 miles from extreme north to extreme south and approximately 1,000 miles from east to west. The outline of the province is very irregular. The most noticeable feature is the vast extent of boundary line which borders on the Great Lakes. The altitude of the lakes varies from 250 to about 600 feet and inland Ontario ranges from lake-level to 1,700 or 1,800 feet. Practically all of the fruit-growing districts lie below 1,000 feet and all the important fruit districts border the Great Lakes.

The early settlers paid less attention to horticulture than to other branches of rural activity, but of late years very rapid development has begun, especially in connection with fruit-growing, although commercial vegetable-growing and commercial floriculture are becoming increasingly important. Landscape art is newer and less developed than are the commercial branches of horticulture, but many of the towns and cities possess active horticultural societies, part of the work of which is a propaganda looking toward the beautifying of home surroundings. Ontario, as a province, possesses great natural beauty. Few sections are entirely level and the general character is undulating or more or less rolling. There are many beautiful homes in towns and cities and many also throughout the countryside.

The many local horticultural societies and the provincial federation of them are exerting profound influence throughout the country on all kinds of amateur horticultural work, and floriculture especially is a feature of very many home gardens and of many school and public grounds as well. In commercial floriculture, the Dale greenhouses in Brampton were until recently said to be the largest range of houses in America, and there are many other up-to-date glasshouse plants in various parts of the province.

Old Ontario lies farther south than any other part of Canada, the most southerly part, as a matter of fact, lying in the same latitude as Boston, Mass., and on a level with the northern boundary of the State of California. In this southern district, the production of early vegetables, both under glass and out-of-doors, has become an important industry. In the vicinity of many towns and of the large cities, such as Hamilton, Brantford, London, Toronto and Ottawa, there have also grown up important local industries in the production of vegetables. The extensive production of such truck-crops as onions, cabbage, and celery is conducted in a few small districts only, but with the rapid development of markets this phase of vegetable-growing is taking on increased importance. In certain sections, such as Prince Edward County, the vegetable industry takes the form of production for canning factories. In that county, there are some sixteen large commercial canning plants, and many additional factories are located in other sections and devote themselves to the canning of full lines of vegetables and fruits. The industry is growing.

The apple is by far the most important fruit produced within the province, but certain sections have for years been producing peaches in a large way. The Niagara Peninsula has long been famed as an important fruit center, and many fine commercial plantations of peach and other fruits are found there. Peaches from this locality are being successfully shipped to Winnipeg and northwestern markets, and a few shipments have also been landed in Great Britain in excellent condition. On the accompanying map, the three districts marked No. 1 produce peaches successfully in a commercial way. The peach section bordering on Lake Huron is of comparatively recent development, but the climate and soil are perfectly adapted to this fruit, and a great extension of acreage has taken place in that locality within recent years. That part of district No. 1 which lies to the north of Lake Erie does not produce peaches as extensively as its area would indicate, but there are numerous localities that can and do grow large quantities of this tender fruit. The section marked No. 1 which lies south of the west end of Lake Ontario is the Niagara district of Canada, and is world-famous.



659. Fruit-regions (numbered) in lower Ontario.

The sweet cherry as a commercial crop is found only in very few localities, and these are practically all in district No. 1. This district is also the only part of the province that grows grapes extensively, as the more northerly sections have not sufficient length of season to ripen the crop. District No. 2 produces most of the plums and pears grown commercially in the province, but the Niagara section of district No. 1 also grows these two fruits extensively. The part of district No. 2 bordering on Georgian Bay was formerly one of the most important plum districts. The only district in the province that produces pears extensively is the Burlington section, lying at the west end of Lake Ontario.

The commercial cultivation of strawberries, raspberries, gooseberries, blackberries, and of sour cherries, is extensive in many districts of the province. Local conditions, such as the presence of urban markets or of canneries, together with the availability of labor, seem to determine the localities which can engage profitably in the production of these fruits. Large quantities of even the most tender fruits, such as strawberries, are shipped west to points in the prairie provinces, and eastward in some cases to Quebec, New Brunswick and Nova Scotia.

The most important apple districts of the province are all included in districts Nos. 2 and 3. The northern, or, more correctly, the upper limit of district No. 2, forms approximately the limit of the commercial cultivation of the Baldwin apple. Other important varieties grown in district No. 2 are Northern Spy, Greening and King. That part of district No. 2 lying to the north of Lake Ontario produces few Baldwins and some Greenings, but the leading variety is probably Northern Spy. District No. 3 grows winter varieties for storage purposes and Northern Spy grown here keeps well until March or April. The counties north of Lake Ontario also produce large quantities of Ben Davis, Gano and Stark. These varieties have been exported in large quantities for many years to European markets.

The area marked district No. 4 in western Ontario lies at a much higher altitude than the surrounding districts and is consequently much colder. There are few apples grown commercially, but the climate corresponds very closely to that of the St. Lawrence River Valley, part of which on the map is also marked district No. 4. The St. Lawrence River Valley has long been noted for its McIntosh Red and Fameuse. The McIntosh Red, by the way, had its origin in Dundas County, not far from the St. Lawrence River, about 1790. (See page 317.)

District No. 5 and the large extent of country lying to the north of Lake Huron and Lake Superior, and extending to James Bay, is comparatively new and untried with regard to its possibilities in fruit-growing. In one or two districts of the great northland, apples are grown successfully in a commercial way. This is true of St. Joseph's Island, Algoma, and of the mainland of Algoma District bordering on the north shore of Lake Huron.

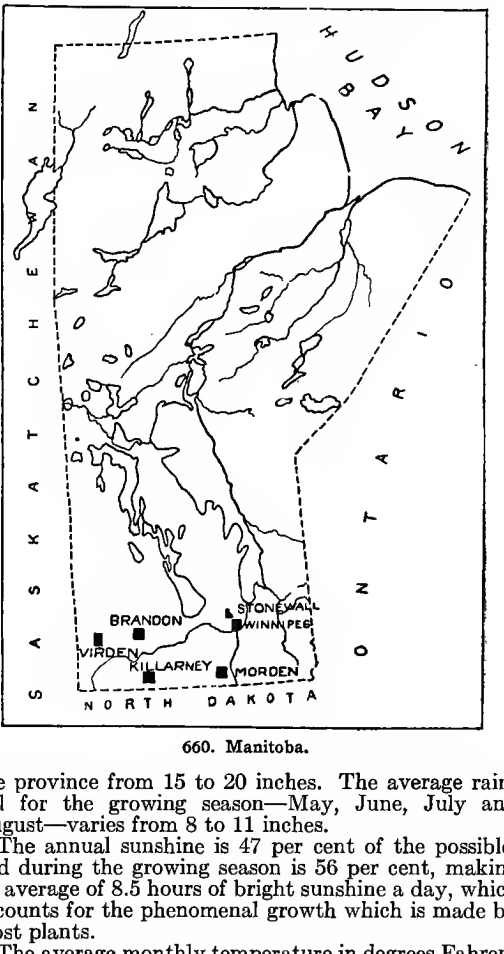
One of the most interesting features of Ontario horticulture is the existence within the province of a large number of very successful fruit-growers' selling organizations. The story of the work done by some of these organizations in reviving the fruit industry in certain previously neglected counties reads like romance. In Norfolk County, on the north shore of Lake Erie, the production of apples increased in ten years from nothing to approximately 50,000 barrels, and this tremendous development came about simply through the care given to the old orchards, many of which had been standing uncared for and idle thirty or forty years previous to the organization of the fruit-growers' association. There are some forty of these associations now doing business within the province, and by their aid Ontario expects in the future to be able to dispose of her fruit successfully in the face of all competition. J. W. Crow.

Manitoba.

In considering the agricultural possibilities of the province of Manitoba (Fig. 660), the subject of horticulture is too frequently overlooked or given scant consideration. The fact that cereals can be grown with great success has been very clearly demonstrated, but up to the present time comparatively few of the persons residing in western Canada have had sufficient confidence in the fruit-growing possibilities of the country to enter the industry on a very extensive scale. However, a few pioneers have opened the way, and to the results of their work one looks for encouragement and guidance.

Geographically, Manitoba lies just north of the international boundary line, extending from longitude 95° W. to 101½° W., or about 276 miles. Since the extension of the boundary, the northern limits are on the shores of the Hudson Bay. The altitude varies from 760 to 1,500 feet above sea-level.

The annual precipitation in the Red River Valley varies from 20 to 25 inches, and in the western part of



660. Manitoba.

the province from 15 to 20 inches. The average rainfall for the growing season—May, June, July and August—varies from 8 to 11 inches.

The annual sunshine is 47 per cent of the possible, and during the growing season is 56 per cent, making an average of 8.5 hours of bright sunshine a day, which accounts for the phenomenal growth which is made by most plants.

The average monthly temperature in degrees Fahrenheit is as follows: January, 1.9; February, .5; March, 14.4; April, 38.2; May, 50.4; June, 60.6; July, 64.6; Aug, 62.1; September, 52.8; October, 40.7; November, 20.7; December, 7.5. Average temperature for the growing season from the first of May to the first of September is 59.2° F.

In a country of such rich agricultural resources as Manitoba, in which excellent crops of cereals can be produced on an extensive scale with a minimum of labor, one would naturally expect that the people would turn rather slowly to the production of fruits, which require much greater care and a much more intensive and exact system of cultivation. The growing of this finer class of agricultural products is usually delayed until the country has become thickly populated and the land has been brought into a fairly good state of cultivation. Making an allowance for the difficulties that must be overcome in the production of fruits, some excellent work has been done and substantial progress made.

Among the valuable introductions is the *Pyrus baccata*, or Siberian crab-apple, which was first planted on the experimental farm at Brandon, in the year 1890,

the trees having been grown at the Central Experimental Farm, Ottawa, from especially selected seed that had been imported from Russia. The introduction of this hardy Russian apple has done much for the advancement of apple-growing in Manitoba. It furnishes a hardy stock on which the tenderer standard varieties may be grafted and their hardiness very much increased. An effort has also been made to increase the hardincss of some of the standard varieties by hybridizing them with *Pyrus baccata*. Several promising hybrids have been produced in this way and are now being grown to some extent in the province. (See page 557).

Among the earliest attempts in fruit-growing in the district of Winnipeg, may be mentioned those of the late W. B. Hall, of Headingly. In the early sixties, some not unsuccessful experiments were conducted by him with currants, tomatoes, gooseberries, Siberian crab-apples and rhubarb. The results were indeed so satisfactory that he and others in the neighborhood were induced to undertake fruit-growing on a limited scale. Among other pioneers whose experiments on fruit-growing have been of value, may be mentioned the late Thomas Frankland, of Stonewall, A. P. Stevenson, of Dunstan, and D. W. Buchanan, of St. Charles. Mr. Stevenson has experimented with apples, plums, cherries, grapes, gooseberries, currants, raspberries and strawberries, and his untiring efforts have been a great incentive to others. He has been very successful in growing apples, particularly the hardy Russian sorts. He has at the present time a number of the better varieties of this class growing in his orchard, practically all of which are yielding good returns, his annual crop being usually over one hundred barrels. The various hardy crab apples also yield good returns. Mr. Stevenson is convinced that apples can be successfully grown in Manitoba if the proper varieties are chosen and the proper conditions provided.

The experimental farm at Brandon has accomplished much for Manitoba horticulture. Hundreds of varieties of the various classes of fruits from different parts of America and Europe have been tested there and the results published. In the month of April, 1899, about 500 fruit trees, consisting of apples, crab-apples, plums and cherries, were placed under test at the experimental farm. These included many of the large standard varieties together with a number of hardy imported kinds. Numerous varieties of grapes, currants, gooseberries, raspberries, blackberries and strawberries were also tested. Many of these plants did not survive the first winter and in a few years only the hardiest sorts were found to be alive. Since the first planting, many other varieties of fruits have been introduced and experimented with and much valuable information has been gained. Among the numerous introductions made was the Russian berry-crab, *Pyrus baccata*. Its extreme hardiness makes it eminently well suited to this country, where it is used as stock on which the less hardy sorts are grafted for the purpose of increasing their hardiness and thereby adapting them to an environment that would otherwise be uncongenial to them.

Small-fruit culture in the province of Manitoba has always been attended with a fair degree of success. Currants, gooseberries, red and black raspberries, and strawberries have been grown since the early settlement of the country. They yield profitable returns when intelligently cultivated. They apparently possess an inherent hardiness not shared by many tree fruits, which renders them much more suitable for the severe climate. It is only a matter of a few years until these smaller fruits will be grown in all parts of the province, in sufficient quantities to supply the local demand.

Another phase of horticultural work to which considerable attention is being given, is the decoration of home- and school-grounds by the planting of ornamental trees, shrubs and flowers. The prairie is bare and unattractive and around many prairie homes there has been a lack of trees and shrubs. The work of beautifying the surroundings of residences is one of the most necessary steps in the horticultural work of Manitoba. Much has already been done in the cities, towns and rural districts by horticultural organizations to increase their attractiveness by ornamental planting.

Practically all garden vegetables, with the exception of a few that require a long season, may be grown to a high state of perfection. The richness of the soil and the shortness of the seasons tend to give a flavor and tender crispness to the vegetables not attainable elsewhere. The heavy yields that may be obtained from these gardens make vegetable-growing a very profitable branch of horticulture, as there is an abundant demand for vegetables in the home market.

The work of fostering horticulture within the province is borne largely by the Agricultural College and certain societies; among the latter are the Manitoba Horticultural and Forestry Association, the Brandon Horticultural and Forestry Society, and others of a more or less local character. The objects of these societies are to bring together those persons interested in horticulture, to assemble horticultural literature, and to stimulate in every possible way a greater interest in horticultural pursuits. Much good work has been accomplished by these societies and to their efforts is largely due the increasing interest that is being taken in the various lines of horticultural work within the province.

There are several directions in which progress may be made in Manitoba horticulture; for example, a better selection of varieties; an improvement by breeding and selection of wild and native fruits and varieties grown in the country; and improved systems of culture. Much is being done in plant-improvement in other parts of the country, and Manitoba also offers an excellent field for the improvement of native fruits. Various wild fruits grow very abundantly in many parts of the province, and if a combination could be effected whereby the hardiness and productiveness of these could be combined with the larger size and better quality of the cultivated fruit, a great step in advance would be achieved. F. W. Brodrick.

Saskatchewan.

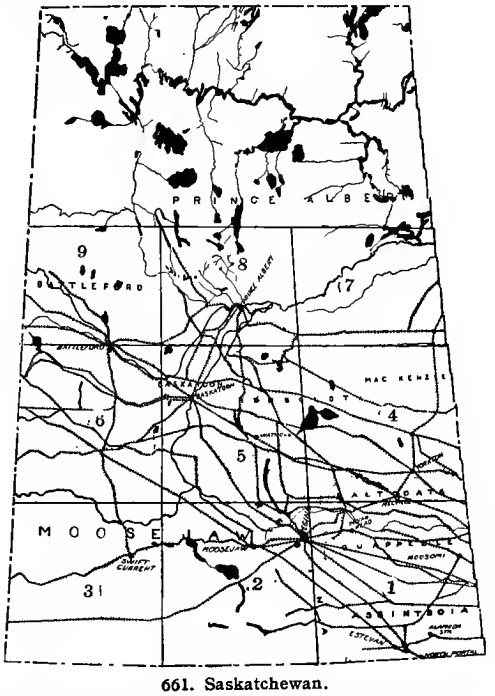
In the map (Fig. 661), all that part of Saskatchewan that need be considered here is shown in the numbered districts, the remainder farther north being still beyond the reach of settlement, although many parts of it will no doubt be found, amidst its lakes and forests, eminently suited to the growing of farm and garden products, where now the lonely trapper and the mink and marten roam. Districts Nos. 2, 3, 5 and 6 are mostly bare prairie, being slightly wooded about some of the hills, river-banks and coulees; district No. 1 has also considerable prairie, but about the center is situated the Moose Mountain Forest Reserve, while mixed prairie and scattered groves of poplar extend over the northeastern part and through districts Nos. 4, 5 and 9, with heavier timber towards the northeast in district No. 7.

The average annual precipitation has been about 17 inches, but hardly more than 15 inches in districts Nos. 2, 3 and 6. Over 12 inches of this occurs from April to September. The elevation is also greater in this southwestern portion of the province, being 2,439 feet above sea-level at Swift Current, 1,884 feet at Moosomin near the eastern boundary, and 1,432 feet at Prince Albert on the Saskatchewan River in the north.

The average mean temperature of Saskatchewan for ten years has been: January, 2.9°; February, 3.8°; March, 14.5°; April, 37.4°; May, 50.2°; June, 57.5°; July, 63.3°; August, 60.5°; September, 50.1°; October, 40.9°; November, 25.0°; December, 10.4° F.

Horticultural industries have not yet been developed

to any extent, and consequently imports of canned fruits and vegetables, fresh fruits and flowers, have been very heavy in proportion to the population, and of exports there have been none. A rapidly increasing resident and floating population, combined with the attractions of grain-farming, to some extent account for this. There is no adequate reason why vegetables, small fruits and flowers should not be grown in quantity sufficient at least to meet the demand of the home market. There is ample evidence at any of the fairs held in the various parts of the province that the soil and climate are suitable for the production of a large variety of vegetables of unexcelled quality. It has been proved that vegetables and flowers can be grown profitably under glass during the coldest winters. The most important points to consider in locating such industries are access to market and cheap fuel. A glance at the map will show many favorably situated distributing points on the network of railway lines, while the lignite of the Souris Valley in the south and the wood of the northland, readily



661. Saskatchewan.

solve the fuel problem without considering the possibilities that lie hidden in the straw piles that accumulate or are burned on the millions of acres of grain fields each season.

Small conservatories and nurseries located at Prince Albert, Moose Jaw and possibly other points, are devoting their attention mostly to winter vegetables, while at Saskatoon 25,000 feet of glass is used in the production of pot- and cut-flowers. There is also a large demand for shrubs and ornamental trees for the beautifying of the homes so rapidly growing in numbers in village, town and city, but few nurseries are specializing in that line. The abundance of native small fruits such as the currant, gooseberry, raspberry, saskatoon, blueberry, cranberry, cherry and strawberry, has to some extent delayed the introduction of cultivated varieties into the gardens of the residents in those portions of the province most suitable for successful fruit-growing, and, on the other hand, those living on the open prairie have first to grow shelter-belts before they can hope for good gardens. When shelter is provided, the hardier varieties of small fruits and crab-apples may be grown without difficulty. There are, however, peculiar weather conditions that should be considered before anything of this kind be attempted on a commercial scale. Bright warm days and cold nights in April, and frosts in May, determine the extent of the fruit crop. It is true, however, that some of the evil effects of freezing and thawing can be avoided by protection of the stems from the direct rays of the sun.

In isolated instances, in sheltered gardens, some of the hardiest varieties of standard apples, such as Hibernal, Anisette and Blushed Calville, are growing and some are producing fruit, but the day is yet distant when it can be said that apples are commonly grown here. The late Director of the Dominion Experimental Farms, Wm. Saunders, since the beginning of these farms, took a keen interest in the finding of suitable fruits for the prairie provinces and in the encouragement of horticulture, and has been ably assisted in this by Angus Mackay, Superintendent of the Indian Head Farm, where the Siberian crab has been found hardy enough to withstand the most severe climatic vicissitudes. This hardy crab has been used in the production of most promising hybrids and as stock on which to root-graft hardy cross-breeds. At the same station varieties of the native Manitoba plum of good quality have been developed. Work of this kind is also being undertaken at the more recently established experimental stations at Rosthern and Scott. Another institution that, under the superintendence of Norman M. Ross, has aided greatly in demonstrating to the people the possibilities in the way of landscape gardening and floral beautification of home surroundings, is the Dominion Forestry Farm at Indian Head, from which many millions of trees are distributed yearly to the farmers on the open plains to be planted, as windbreaks and shelter-belts, under expert supervision. Much encouragement was given to the horticulture of the Northwest Territories, and Saskatchewan especially, by the interest displayed by A. E. Forget, recently Lieutenant-Governor, and the skill and success of his popular gardener, George Watt, who was ever ready to advise and assist the inquiring amateur. Probably no farm in the province could boast of so attractive a garden as that of Gerald Spring-Rice near Pense, where in typical Old Country fashion its labyrinth of walks mid the choicest of flowers and shrubs, was centered by a sun-dial. Another farm on which the possibilities in the way of garden and fruit-culture have been demonstrated is that of George Harvey in the Indian Head district, where shelter-belts, shade trees and hedges provide the protection so necessary for success in horticulture and nesting-places for the birds that are of so much assistance in controlling insect form. Personal mention should also be made of John Ashworth, a member of the legal fraternity, who, from love of flowers and the pleasure of overcoming obstacles, established the Saskatoon Nursery Company, which is now a profitable industry.

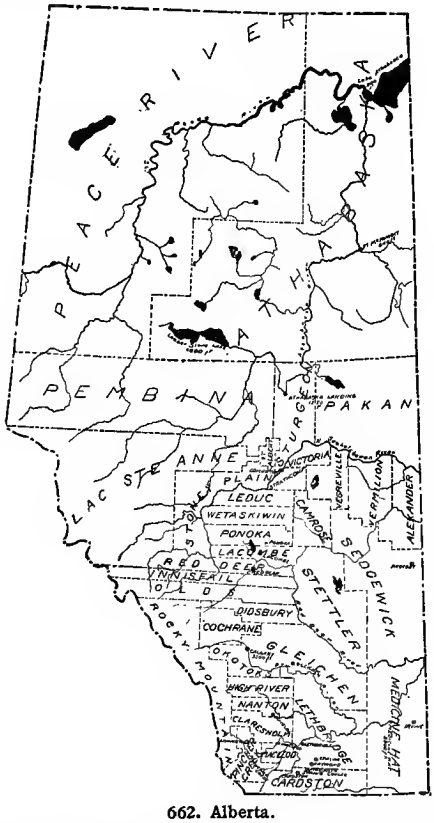
So closely is bee-keeping associated with successful fruit-growing, that it may not be out of place to say that very few in this province have yet turned their attention to the production of honey, although it has been amply demonstrated that bees make honey of excellent flavor from the abundance of wild flowers on the prairie; and bees may be safely wintered notwithstanding the severity of the frost at times.

There are now only two horticultural societies in the province, one being located at Regina and in receipt of an annual civic grant, the other having been just started at Saskatoon. No direct aid to horticulture is given by the provincial government, but through the Extension Department of the University of Saskatchewan, the agricultural societies and the homemakers' clubs may draw grants founded on their prize lists, in which horticultural competitions may assume a prominent place and expert judges are furnished when required. There is no

horticultural school at present in the province, but a department of horticulture is planned for the College of Agriculture and will no doubt be equipped in the near future, but at present the only instruction given is through qualified practical horticulturists sent out by the Extension Department to address meetings throughout the province. T. N. WILLING.

Alberta.

Alberta (Fig. 662), is the farthest west of the three prairie provinces of Canada. Its eastern boundary is the 110th parallel of longitude, and its western boundary for about 500 miles north is the summit of the Rocky Mountains; and beyond this point, its western boundary is the 120th parallel.



662. Alberta.

From a climatic point of view, the province naturally divides itself into four principal regions,—southern Alberta, central Alberta, northern Alberta, and the foothills or highlands district. The latitude of the northern part of the province is offset to a great degree by its lesser elevation.

Northern Alberta may be said to be that part of the province lying north of a line drawn east and west through Athabasca Landing. The whole of this district is still practically unsettled, although people are going in; a few small older settlements are scattered here and there about the fur-trading posts, and all the common garden vegetables, as well as farm crops, are grown at these places, as far north as 400 miles beyond Edmonton. Wild currants, gooseberries, strawberries, raspberries, and saskatoons or Juneberries are plentiful throughout the region. The country is more or less bush-covered or park-like, and is, in this way, protected from the winds that sweep over the open country in the south. In view of what has been accomplished in fruit-growing in the south, at a higher altitude and under wind-swept conditions, it is reasonable to expect that at least some of the hardier apples and crabs will in time be grown successfully in the far north. The soil of northern Alberta is a deep black humous loam, and its very richness constitutes a danger from a horticultural point of view. There is usually an abundance of rainfall, and the difficulty with fruit trees under such conditions is to get them matured-up before winter. No reports are at hand as to attempts at growing fruit in northern Alberta. The distance from the railways is so great that plants are usually dried out before reaching their destination, but as railways are now being pushed north, it will doubtless not be long before promising results will be secured.

Central Alberta may be said to comprise the region lying south of northern Alberta as far as a line drawn through Red Deer to Provost near the Saskatchewan border. Its soil, climate, and other features are similar to those of northern Alberta, although the altitude in the central part of the district is greater, rising at Lacombe to over 2,900 feet. It is the oldest settled part of Alberta, and is covered with well-handled farms, whose owners, having been some years in the country, have had time to make experiments in fruit-growing. Apples have been produced near Edmonton, Ponoka and Red Deer, and crabs have been grown at the Dominion Experimental Farm at Lacombe and also at Calgary. Small fruits are grown successfully all over the district. The influence of the difference in altitude is very marked in this territory, as ornamental trees, such as the soft maple (*Acer saccharinum*) and the American basswood (*Tilia americana*) are hardy in Edmonton, while they are a failure farther south at higher altitudes, and with similar soils, shelter, and rainfall.

The Highlands of Alberta may be described as the country south of the Red Deer River, east as far as a line drawn north of Gleichen on the main line of the Canadian Pacific Railway, and thence running southwest to Stavely on the Calgary and Macleod line, and from that point south to a point north of Cardston, and thence east through Spring Coulee. Its western boundary is the boundary of the province. This is the highest part of the cultivable land of Alberta, rising to a height of over 4,000 feet. A very small area of the northern part of this region is wooded, the remainder being open and often wind-swept prairie, with the additional harassment in the south of the warm chinook winds. In appearance, this southern section is not unlike the country east of it, while it is still in the "dry" belt, with a rainfall reaching in certain places at times over 20 inches. It has a little more precipitation than southern Alberta to the east of it. This increased precipitation causes longer and thicker grass, and this growing and dying down for generations has left a richer soil, which in turn encourages late growth in trees. This, coupled with the often shorter season between frosts, incident to its higher altitude, will probably preclude the possibility of apple-growing becoming general in the higher districts unless in favored spots. The hardier varieties of small fruits do well in this region, and at Cardston, 12 miles from the United States boundary line, at an altitude of approximately 4,000 feet, apples have been grown by a number of persons. At Joe McFarlane's ranch about 6 miles from the Livingstone Range of the Rocky Mountains, at an altitude of over 4,000 feet, Hyslop crabs have been ripened. These successes were in sheltered situations; and while this district may never become known as apple-producing, still these cases serve to show what may be done in isolated instances in which conditions are favorable, and may be accepted as an indication of what may become more general in years to come.

Southern Alberta proper is the district lying east of the foothills, and south of central Alberta. It also has conditions peculiarly its own. The prairie is bare of trees, and while the soil is of excellent quality, it is not the black, deep, vegetable mold of the other parts of the province. It is what may be classified as a friable clay loam, that is, a rich clay loam containing enough sand to enable it to be worked easily. It is in the dry belt, and the rainfall ranges from 12 to 15 inches per annum. Being bare, it is often windswept, and gardening without shelter-belts will never be successful. It is the home of the warm chinook winds, and these may come at any time, and often in a few hours, or even minutes, a rise of temperature from 30° below zero to 8° or 10° above freezing will take place. This is an extreme change in temperature, and if the warm wave is followed, after a few days or weeks, by a cold spell, it cannot fail to be a severe trial to growing trees. These rapid changes in winter have been declared by many of the old settlers to be the cause of the scarcity of trees on the prairie. This, however, is to a large extent a fallacy, as is being now proved constantly by the successful growth of shelter-belts of suitable species all over the country, and exposed in the fullest degree to the influences of the chinooks. The lack of rainfall, however, does constitute a menace to successful fruit-growing, for if there is a scarcity of moisture in the soil in the fall, there is invariably greater risk of dead trees in the spring. Snow cannot be depended on to preserve the moisture, or to supply it, as only about twice in thirty-eight years has it lain steadily the whole winter. The dry winds drift the snow off, and the chinooks melt it, so that in winter for weeks at a time the grouud may be bare of snow. Cultivation to preserve the moisture is a necessity, though irrigation in the fall, in some districts in which it can be done, is of great assistance in carrying the trees over winter. Notwithstanding all these untoward circumstances, a number of apple trees are growing and producing fruit in southern Alberta. Settlement has been general only in the last ten years, and yet in that time many successful experiments in fruit-growing have been made, possibly more in the same time than in the history of any of the other prairie provinces. Apples, crabs and plums have been growing in several gardens for the last seven or eight years in Medicine Hat, Irvine, Lethbridge, Magrath, Calgary and Macleod, and they also have been grown in several instances at Stirling and Raymond. Thus, although southern Alberta would appear at first sight to have natural conditions unfavorable to large-fruit-growing, experience shows that, in spite of these, it is possible to do so. It would seem as if the dryness of the country, intensified perhaps by the influence of the chinook, tends to ripen the annual growth before frost comes in the fall, so that the trees do not winterkill. There is no doubt, also, that the nature of the soil has much to do with this early ripening, lacking as it does the stimulating effect of the more vegetable soils of the north. Experience in grain crops and forest trees serves to bear this out. However, it is still doubtful whether southern Alberta will ever become a fruit country. The high winds that occur at any time in the spring and fall may interfere greatly with the setting or maturing of the fruit, and, as a consequence, the regularity of the supply. There is no doubt, however, about the farmer in time being able to grow fruit enough for his own use, with the help of shelter-belts. When fruit is grown under irrigation in Alberta, care must be taken to avoid irrigating after the last of June. If water is applied after that time, there is usually grave risk of winterkill, or rather fallkill, as the trees continue growing late into the fall and are not mature when the first frost comes. Even cultivation to preserve the moisture should not be carried on later than July 15.

There is no provincial horticultural society, and no state aid devoted purely to horticulture, although much good work is being done by the experimental farms, maintained by the Dominion government. These, however, have not been able to do much as yet, having been established only six years. The chain of demonstration farms which is being established by the provincial government will probably be of some assistance in this direction. There are two fairly strong local horticultural societies at Edmonton and Calgary.

ARCH. MITCHELL.

British Columbia.

In the time since the Cyclopedia of American Horticulture was published, horticulture in British Columbia (Fig. 663) has passed through the experimental stage. Although the province is one of the largest in area in Canada, its population in 1891 was only 98,000; in ten years it had almost doubled; and in twenty years the census of 1911 shows a population of 362,000, of which over half is urban in character, and located on the coast. While practical experiment has shown that different forms of horticulture can be most successfully conducted commercially under the widely diversified conditions existing throughout southern British Columbia, development has been so recent that only the fringe of its possibilities has been touched. Yet, even now the province has gained such a reputation as a fruit-growing country as to warrant a rather full description here.

Fruit-growing in British Columbia has been inspired by the success that the industry has attained in the states of Oregon and Washington directly to the south, in which conditions of climate and soil are not dissimilar, and by the rapidly increasing demand for fruit, not only by the growing population of the province, but by the phenomenal increase in demand from the Canadian prairie provinces, which cannot possibly produce all their own fruit. Early dreams of possible markets for all the horticultural products of the province have been far surpassed by the actual development of the market. The population of western Canada was in 1911 over three times as great as in 1901. On the other hand, fruit-growing is now firmly established as one of the commercial industries of the province and though lumbering, manufacturing and mining surpass agriculture in the amount of wealth now being produced, fruit-growing will in a few years aid in bringing the returns from agriculture well to the front.

In general physical features British Columbia is mountainous, the greater part of the area being covered by the Rocky, Selkirk, Cascade and Coast ranges, between which lie the valleys of the rivers and lakes in which agriculture is being practised. It is probable that about one-twentieth or one-thirtieth of the entire land is cultivable. The land is, therefore, usually fertile, and in many districts unusually so. The climate is remarkably varied. The greater part of the cultivated area of British Columbia lies within the upper austral and transition zones. On the coast the atmosphere is humid, the rainfall copious and the annual temperature has a very limited range. In the interior, continental temperature conditions prevail, and in most of the interior valleys it ranges from zero to 90° or 100° as the extremes. Some of the interior valleys have a total precipitation of only 8 or 9 inches, while others run from 35 to 40 inches. Irrigation is essential in the first-mentioned, not in the latter. A large percentage of British Columbia horticulture is conducted under irrigation. The altitude of the horticultural districts on the coast varies from a few feet above sea-level to 400 or 500 feet above. In the interior valleys the altitude runs from 800 to 2,800 feet, and even to 3,300 feet, above sea-level.

Among the tree fruits grown in the province, the apple holds preëminence, and especially is this true in the arid and humid valleys of the interior, in which many varieties of apples reach a degree of perfection

not excelled elsewhere. The interior valleys now ship about 600 carloads of apples to prairie and coast markets, and to Australia, China, Japan and England. Pears are largely planted, not only in the interior, but also on the coast where they are relatively more successful than are apples, the principal varieties being Bartlett, Clairgeau, Anjou and Flemish Beauty. Plums and prunes are also of considerable commercial importance, the Pond Seedling or Hungarian being the principal plum, although the Italian prune is more largely grown commercially than any other variety of either plum or prune. Peaches are practically confined to the Lower Okanagan valley, and the Triumph, Early Crawford, Yellow St. John and Elberta are most largely grown commercially. The total shipments probably aggregate about 100 carloads. Cherry trees are planted throughout the province on a commercial scale, the hardier sweet cherries, especially the Bing, Lambert and Royal Anne throughout the interior, while on the coast the Olivet and English Morello, both preserving cherries, meet with particular success, the growers obtaining an average of 11 cents a pound for a period of years. Not the least important among the tree fruits are the crab-apples, particularly Transcendent and Hyslop, grown most largely in the Okanagan Valley. The Transcendent is thought to be the most profitable apple for a period of years in the province. Prairie markets have recognized the superiority of the British Columbia crab-apple and are paying prices extremely satisfactory to the fruit-grower. The apricot is grown to some extent in the warmer interior valleys. Nut trees are being experimented with throughout the province and indications are that some varieties of walnuts will prove commercially profitable on the coast.

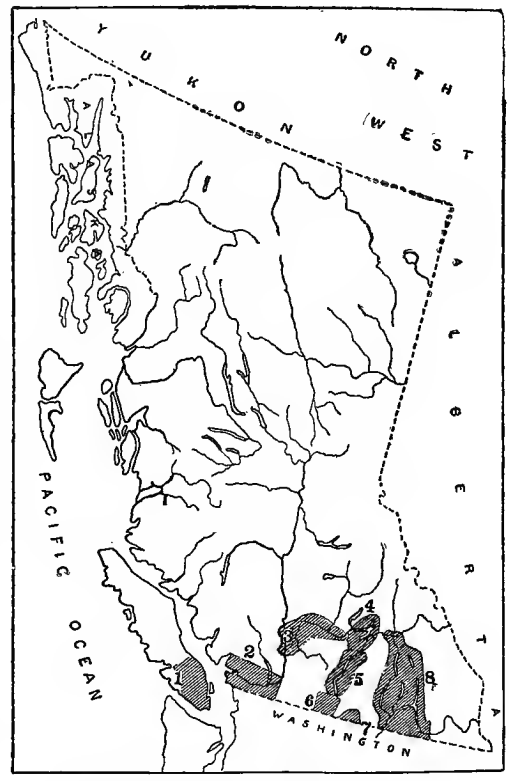
In small-fruits British Columbia has some areas, especially those contiguous to the delta of the Fraser River, that are preëminently adapted to the strawberry and raspberry; the loganberry also flourishes in the coast regions and is proving profitable. Blackberries are grown to some extent on the coast, as are currants and gooseberries, although the latter are inclined to mildew, with the exception of the Oregon Champion, a western variety now grown almost exclusively. The interior valleys, especially those having a more humid climate, are growing strawberries and raspberries commercially to an increased extent. Taken as a whole, however, the acreage in small fruits is only a small fraction of that devoted to tree fruits, and this is quite likely to be the case indefinitely.

Vegetable-growing is practised throughout the province, the white potato, onions, tomatoes, cabbage, and celery being the principal crops in the order named. The potato is grown as a field crop in practically all districts and the average yield an acre in 1911 was 230 bushels. British Columbia potatoes won the Stillwell trophy at the National Land and Irrigation Exposition, New York, 1911, which proves the general excellence of the soil and climate of the province for the crop. The potato-beetle is unknown and blight is not usually serious enough to warrant preventive measures. Potatoes are shipped in commercial quantities to the Yukon, to northern British Columbia, to the coast cities, to the mining camps and to the prairie provinces. The acreage in 1911 was about 13,000 acres and this was increased in 1912. The onions, of which the Yellow Globe Danvers is grown in the Okanagan Valley to the extent of about 100 carloads a year, are shipped to coast and prairie markets. The summer nights are too cool for the tomato except in the arid interior valleys where they are grown in large quantities both for shipping fresh and for canning purposes. Cabbage, celery and other vegetables are grown on an extensive scale commercially on suitable soils throughout the province, notably at Armstrong.

The greenhouse business surrounding the cities of the coast, has trebled in volume in three years, and openings still remain for its extension throughout the province. Bulb-culture is making progress in the district surrounding Victoria, and will become an important commercial industry when labor becomes cheaper.

The regions are shown on the map (Fig. 663). Horticulturally British Columbia is as yet almost confined to the southern part, and only the different areas so included are here discussed.

Districts Nos. 1 and 2 on the map are distinctly coastal in character. The Japanese current tempers the climate throughout the entire year so that zero weather is very uncommon, and the summer temperature very rarely reaches over 80°. The humidity is high almost throughout the year, and the annual



663. Horticultural Regions of British Columbia.

precipitation (which is nearly always in the form of rain) runs from 30 to 120 inches, the average in the horticultural areas being around 55 inches. This falls largely in the winter months, and July and August are often so very dry as to cause a loss from drought. This area has a remarkably long growing season. Owing to the coolness of the nights, tomatoes, corn, and the like do not ripen. Early apples do well, but winter apples cannot be matured successfully. Fungous diseases also restrict apple-culture to a serious extent. Pears, however, do well; small-fruits do exceptionally well, and preserving cherries are very profitable. District No. 1, being the southeastern part of Vancouver Island, with an annual precipitation of about 40 inches, is rather drier than the lower mainland district No. 2, but this difference has no great influence on the character of its products. In these districts only a small proportion of the land suitable is being made to produce what it is capable of producing. The local markets still import considerable quantities of produce from California, Oregon and Washington.

XIX. Canadian orchard development.—The bench lands of British Columbia.

The second great horticultural region of southern British Columbia is the dry-belt. It lies just east of the Cascade Mountains, is about 200 miles wide and extends northwest from the interior boundary about 250 miles. In it are districts Nos. 3, 5, 6 and 7 as indicated on the map. Its valleys lie at an elevation of 800 to 1,500 feet above sea-level. The annual precipitation totals from 9 to 15 inches, distributed fairly evenly throughout the months of the year. The atmosphere is dry and bracing. Sunshine is plentiful and in the summer months almost constant. The winter extremes of temperature are lower than on the coast, and the summers are very much warmer. It is the great apple-, peach-, tomato- and potato-producing district of the province, all of its products being grown under irrigation, and mostly marketed in carloads on the coast and in the prairies. Of its valleys, the Okanagan (No. 5) is the most advanced and the largest shipper; Thompson River (No. 3) and the Kettle River (No. 7) produce winter apples and potatoes as their staple crop, while the Similkameen Valley (No. 6) produces principally peaches and winter apples.

The third great horticultural region in British Columbia may be called the semi-humid interior belt, embracing districts Nos. 4 and 8. Here irrigation for most crops is not necessary, although for small fruits it is desirable. The annual precipitation runs from 18 to 45 inches, a considerable portion of which falls as snow, while June is a month of considerable rainfall. The air is more humid than in the dry-belt and extremes of temperature of winter and summer are not so great. The humidity makes fungous diseases a problem and spraying for apple-scab is necessary. Unlike the dry-belt, it is a timbered country, and the cost of land-clearing offsets the cost of irrigation systems in the former. District No. 4, in the water-shed of Shuswap Lake, is as well advanced as the Okanagan Valley, the principal shipments from Armstrong and Salmon Arm being apples, potatoes, celery and cabbage. District No. 8, the West Kootenay, has not thus far been a shipping district, the local demand in the mining camps of Rossland, Slocan and the Crow's Nest consuming more than the locality produces.

The following tabular statement indicates the adaptabilities of the different regions:

District	Present greatest production	Best commercial plantings
1. Island.....	Strawberries, King and Wealthy apples, pears, plums, and Italian prunes.	Olivet and English Morello sour cherries, King apple, Bartlett, Clairgeau and Anjou pears.
2. Lower mainland.....	Strawberries, raspberries, plums and prunes.	Strawberries, raspberries, King apple; also the above pears.
3. Thompson Riv.	Various winter apples.	Wealthy, McIntosh, Jonathan and Wagener apples.
4. Shuswap Lake Section.....	Various winter apples.	Jonathan, Wagener, Spy and Grimes apples.
5. Okanagan Val.	Various fall and winter apples, pears, plums, peaches and prunes.	Hyslop and Transcendent crabs, Duchess, Wealthy, McIntosh, Jonathan, Wagener, Y. Newton, Spitzenberg, Northern Spy, and Rome Beauty apples.
6. Similkameen ..	Peaches and winter apples.	Jonathan, Wagener, Y. Newton, Spitzenberg, Winesap, and Rome Beauty apples.
7. Kettle River...	Fall and winter apples.	Wealthy, McIntosh, Jonathan, Wagener, Rome Beauty and King apples.
8. W. Kootenay...	Strawberries, fall and winter apples, plums, prunes and pears.	McIntosh, Gravenstein, Wagener, Jonathan and Northern Spy apples.

The Dominion census of 1891 credited fruit with a total of 6,500 acres. By 1901 this had been increased only to 7,500 acres, but in the decade just passed tree-fruit-planting has had a tremendous impetus and the acreage at the beginning of 1912 was thought to be around 40,000 acres, of which 93 per cent is apples, 4 per cent pears; the remainder, plums, prunes, cherries, apricots and peaches. The report of the provincial statistician shows that in 1911 there were 15,454 acres of vegetables, of which potatoes constitute some 13,000 acres, tomatoes and onions supplying the majority of the balance. Potatoes average 6.9 tons or 230 bushels to the acre, while other truck crops average 11.4 tons to the acre. The value of the fruit and vegetable products of 1911 was $5,084,241.

In floriculture and in landscape gardening, British Columbia is only making the first steps. In the cities, especially those of the coast, there are many fine gardens and estates, and the coast cities are developing admirable park systems.

The exact records of the first fruit trees imported, it has not been possible to obtain. It has been learned that the Hudson Bay Company was instrumental in bringing the seeds or seedling apples from California to its forts Camosum and Langley sometime previous to 1850. These old orchards are not now in existence. Orchard-planting on the coast during the period 1850 to 1885 was almost altogether of an experimental character, and nothing commercial was expected from it. From that time, and especially after the formation of the British Columbia Fruit-Growers' Association in 1890, experiments in commercial orcharding were begun. Among the first orchards in the interior country might be mentioned those of Thomas G. Earl of Lytton; that of Fred Gartrell at Trout Creek; and that of Frank Richter at Keremeos. Later on came the planting of the Coldstream orchards owned by Lord Aberdeen, under the supervision of John Craig, and T. W. Stirling's orchard at Kelowna. All of these orchards are still in bearing and have produced the wonderful fruit that has done so much to stimulate the large plantings that occurred between 1900 and 1912.

The British Columbia Fruit-Growers' Association, founded in 1890, has been in continuous activity since that time, and has done a great deal to stimulate and encourage the fruit industry and to secure governmental aid and recognition for it. With the British Columbia Fruit-Growers' Association are affiliated all the fruit-shipping and educational fruit-growers' organizations of the province.

The provincial Department of Agriculture has done very much to stimulate interest in the industry, and to protect it from the invasion of insect pests. The Horticultural Board, organized under the auspices of the Department to study the problems connected with the industry, and especially the control of pests, has through its inspectors succeeded in keeping the province free of codlin-moth, San José scale, Colorado potato-beetle, plum curculio and many other insect pests which increase the cost of production in other districts.

Four years ago the Department organized the Horticultural Branch, which is devoted to supplying information on horticultural subjects to the many new settlers embarking in the industry. The Horticultural Branch maintains sufficient assistant horticulturists to forward this work in the various districts. It has inaugurated a series of schools to teach fruit-packing, publishes literature including a list of fruits recommended for planting, and is generally at the service of the fruit industry along these lines. The Department has done much to make the possibilities of the province known by means of advertising and inspection work, British Columbia having won the highest possible awards from the Royal Horticultural Society in London, England, against all the other colonies of the

Empire for six years in succession, fruit being every year exhibited. There are no horticultural schools in British Columbia, the nearest approach to these being the short courses conducted by the Horticultural Branch of the Department. Provision has, however, been made for an agricultural college, which is now being put under way, and in this institution ample provision will be made for investigation and experiment as well as education in horticulture. R. M. WINSLOW.

BRÌZA (ancient Greek name for a kind of grain, probably rye). *Gramineæ*. QUAKING GRASS. Annual or perennial grasses, with open panicles of handsome spikelets; grown in gardens.

Spikelets several-fld., flat, triangular or heart-shaped; glumes strongly concave, these and the lemmas usually horizontally spreading.—Species 12, in temperate regions, 3 intro. into the U. S. These and one or two others also cult. for ornament, the panicles being suitable for bouquets.

664. Briza maxima. (×½)

A. *Plants perennial.*

mèdia, Linn. COMMON QUAKING GRASS. Culms erect or decumbent at base, 1–2 ft.; panicle pyramidal, many-fld., the branches stiffly spreading; spikelets nodding, 3 lines long, triangular-ovate.

AA. *Plants annual.*

màxima, Linn. Fig. 664. One to 2 ft.: panicle drooping, few-fld.; spikelets ovate, large, ½in. long, 5 lines broad, the pedicels slender, drooping. G.M. 47:175. V. 3:246.

mìnor, Linn. Four to 15 in.: panicle erect, many-fld., the branches stiffly spreading, the branchlets capillary, spreading; spikelet triangular-ovate, 1½ lines long.—This species is known to gardeners also as *B. gracilis* and *B. minima*.

B. geniculàta, Thurb.=Eragrostis obtusa, Munro.

A. S. HITCHCOCK.

BRIZOPÒRUM: *Desmazeria*.

BROCCOLI: *Cauliflower*.

BRODIÆA (J. J. Brodie, a Scotch botanist). *Liliàceæ*. BRODIEA. West American cormous plants of low growth, a few of which are now becoming popular in some parts of the country for spring bloom.

Flowers several on a scape: pedicels jointed: the perianth mostly funnelform and non-saccate, not contracted in the throat, ranging from purple to red, white and yellow; stamens 6, 3 of them sometimes reduced to staminodia: lvs. all radical, narrow, usually few, sometimes evanescent. Monographers include under Brodiæa a number of genera erected by other authors, as Hookera, Triteleia, Milla, Calliprora, Hesperoscordum. (The oldest generic name of the group thus constituted is Hookera, but Brodiæa is one of the "nomina conservanda" of the Vienna code, retained because of its general use in the 50 years following its publication and since). For horticultural purposes, it is better and more convenient to merge all into Brodiæa. In this broad sense Brodiæa includes about 30 species, which must be divided into several groups. Monogr. by Baker, in G.C. III. 20, pp. 213, 238, 459; also Watson, Proc. Amer. Acad. Arts and Sci. 14:236. Closely related genera are Bloomeria, Brevoortia and Stropholirion.

The brodieas are valuable for naturalizing in California and the West, as they can be grown very easily. In colder climates they are worthy a trial for the same purposes but probably better for specimen-beds or the coldframe for cutting. They bloom during May, June and early July. *B. capitata* is the earliest to flower. The flowers are very lasting and beautiful for cutting. Unless planted in large numbers they are of little value for color-massing in beds, but most beautiful and dainty when planted in rockwork or with delicate plants such as ferns, heucheras, or columbines. While there is room for much variation in the treatment of the different species, several growing well in very wet soils while others can be grown even in rock fissures or grit, it will be found that the following general treatment will bring success.

On the Pacific slope, brodieas will grow well and can be naturalized in any soil or situation except in heavy shades or generally wet places or in heavily manured or much-watered soils. When the soil is somewhat sandy or gritty, or has been lightened with road grit, spent tan-bark, leaf-mold or any light material, they will usually thrive best. It is questionable whether they are quite hardy east of the Rockies and north of Virginia. The soil should be well drained, and a winter covering of leaves should be given. Plant in the fall before the ground is frozen up, from 2 to 3 inches apart and not deeper than 2½ inches, water sparingly, and ripen well after flowering. It is unnecessary to lift the bulbs in the summer on the Pacific slope but probably advisable east of the Rockies, unless they are kept dry in summer by placing glass over them.

All brodieas grow readily from seeds, but it requires several years to flower them. Many species produce offsets which, if detached, soon flower. If potted early and placed in coldframes, they can be forced gently.

In the following taxonomy, the species have been thrown into four more or less marked horticultural groups.

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Group 1.—In this group, which contains some of the best species in cultivation, the plants have a fibrous-coated flattened corm, resembling that of the crocus; not usually bulbiferous. The lvs. are few, all radical and grass-like: scapes slender but stiffly erect, naked except for bracts below the many-fld. umbel; fls. usually broadly tubular, borne on slender pedicels, in purples, white and yellow; anther-bearing stamens 6. All are hardy, but a protection of straw or lvs. is advisable in the colder regions. A light, loose, well-drained, sandy or loamy soil best meets their needs, and an excess of moisture and very rich soils are to be avoided.

A. *Segms. equaling or exceeding the perianth-tube.*

1. **ixioìdes**, Wats. Dwarf, 3 in. to 2 ft.: lvs. linear, fleshy: fls. few to many, on pedicels 1–4 in. long, in shades of yellow and often purple-tinged, 1 in. or less long; filaments winged, 2-toothed above. S. Calif. to Ore. B.R. 1590. B.M. 3588 (as *Calliprora lutea*). G.C. III. 20:459.—Many handsome varieties. The best is var. **splèndens**, Hort., with large, bright yellow fls.,

the limb wheel-shaped. Var. **mìnor,** Hort. Dwarf: fls. yellow, with dark band and blue anthers. Var. **erécta,** Hort. Dwarf.

2. **hyacinthìna,** Bailey (*Triteleìa hyacinthìna,* Greene). From 1–2 ft.: lvs. linear: fls. 10–30, 1 in. or less long, milky white or purplish. Calif.—Perhaps this and *B. lactea* are forms of one species.

3. **láctea,** Wats. (*B. hyacinthìna* var. *láctea,* Baker). In the type, has the habit of *B. laxa,* but the fls. have a short tube with a rotate corolla, and are white, with green midvein; filaments deltoid. Calif. to Brit. Col., in many forms. Watson combines the *Hesperoscordum lacteum* and *H. hyacinthinum* of Lindley, B.R. 1639, into this species *B. lactea,* thereby not recognizing a *B. hyacinthina.* Baker, however, unites the *B. lactea* form with *B. hyacinthina,* describing var. *lactea* as "more slender than the type, with white fls. and longer pedicels." G.C. III. 20:459.—Var. **lilácina,** Wats., is much stronger, very bulbiferous, grows in wet, heavy soils, and has a larger fl., which is usually lilac-colored. Var. **màjor,** Purdy. Like var. *lilacina,* but fls. white.

4. **grácilis,** Wats. A tiny species, with small yellow fls.: scape 2–4 in. and purplish: lf. 1: fls. ½in. long, on pedicels of equal or greater length; filaments elongated and very slender. S. Ore.

AA. *Segms. shorter than the tube.*

5. **láxa,** Wats. Strong plant, 1–2 ft.: lvs. linear: fls. many, broadly tubular, purple; tube very narrow, and exceeding the segms.; filaments very slender; stamens in 2 rows. N. Calif. B.R. 1685 (as *Triteleia laxa*). G.C. III. 20:241.—Showy, and one of the best. There are many variations.

6. **cándida,** Baker (*Triteleìa cándida,* Greene). Much like *B. laxa* in character of bloom, but fls. only 6–10, and segms. white or bluish with a green vein, and the fls. set at an angle on the pedicel, so that they all face one way: further distinguished by early flowering and the very broad and glossy, scarcely carinate lvs. Calif.

7. **pedunculàris,** Wats. (*Triteleìa pedunculàris,* Lindl.). Still stouter (1–2 ft.), with smaller and fewer white fls. on pedicels a few inches to a foot long; filaments short or none. N. Calif. G.C. III. 20:243.—This species grows in wet, heavy ground close to water, and is very cormiferous.

8. **Brídgesii,** Wats. Fig. 665. Similar to *B. laxa,* but stamens in one row, corolla with a spreading limb and sub-cylindrical tube, and color reddish purple; filaments deltoid. Cent. Calif. G.F. 1:126 (adapted in Fig. 665).—Grows a foot or more high.

9. **Héndersonii,** Wats. Resembles *B. Bridgesii:* yellow, banded purple: filaments somewhat winged, but not deltoid: small-fld. S. W. Ore.

Group 2.—Corm not flattened, bearing many strong offsets, the coating hairy and reddish: lvs. linear and grassy: scapes stiff, few-fld.; fls. large, of a thick, waxy opaque texture, funnelform (except *B. Purdyi*), very lasting, usually purple, in an open umbel; perfect anthers 3. These brodieas are native to a heavy soil, in rather moist situations, and are hardy. They will thrive under conditions recommended for Group 1. (*Hookera*).

A. *Fls. funnelform, with a prominent tube.*

B. *Scape not rising above ground.*

10. **terréstris,** Kellogg (*H. terréstris,* Brit. & Greene). Scape short or practically none, the umbel sitting on the earth: lvs. nearly terete: fls. ¾–1 in. long; staminodia emarginate, yellowish; anthers sagittate-oblong. Cent. Calif., along the coast.

BB. *Scape evident.*

C. *Staminodia as long as anthers, or longer.*

11. **grandiflòra,** Smith (*H. coronària,* Salisb.). Scape 4–10 in. high: lvs. nearly terete, dying before the fl.-st. appears: fls. 3–10, bright blue, of good size (1 in. or more long), segms. longer than tube, very lasting; staminodia obtuse; anthers linear. Calif. to Brit. Col. B.R. 1183. B.M. 2877. G.C. III. 20:213.

12. **califórnica,** Lindl. (*H. califórnica,* Greene). Much like *B. grandiflora:* scape longer (12–30 in.); fls. 10–25, 1½–2 in. long, rose to deep purple; staminodia linear and cuspidate. N. Calif. G.C. III. 20:215.—"The finest species for garden purposes," according to Baker.

13. **mìnor,** Wats. (*H. mìnor,* Greene). Much like a small *B. grandiflora:* scape very slender, 3–6 in.; fls. 2–6 and only ½–1 in. long; staminodia broad and usually emarginate; anthers oblong. Calif. to Ore.

14. **stellàris,** Wats. (*H. stellàris,* Greene). Low: scape with long pedicels and 3–6 bright purple fls., with white centers: lvs. nearly terete: anthers winged behind: staminodia white, longer than the stamens, emarginate. N. Calif. G.C. III. 20:213.—Very pretty.

665. Brodiæa Bridgesii. (plant × ½)

15. **ròsea,** Baker (*H. ròsea,* Greene). About 3–6 in.: lvs. nearly terete: fls. 5–8, under 1 in. long, rose-red; filaments dilated; staminodia white, obtuse and entire, longer than the anthers. N. Calif. G.C. III. 20:213.—A pretty species.

CC. *Staminodia markedly shorter than anthers.*

16. **Órcuttii,** Bailey (*H. Orcuttii,* Greene). Plant rather stout, a foot or more high: lvs. linear, flat or nearly so: fls. 5–15, less than an inch long, short-tubed, lilac; staminodia a small triangular scale, or none. S. Calif. G.C. III. 20:215.

17. **filifòlia,** Wats. (*H. filifòlia,* Greene). From 6–12 in.: lvs. slightly flattened: fls. 3–6, ¾in. or less long, dark-colored; staminodia triangular, twice shorter than the anthers. S. Calif.

AA. *Fls. short and flaring.*

18. **Púrdyi,** Eastw. Different from others in having a short-tubed fl. with broadly spreading, declinate segms., the throat constricted. Cent. Calif., in Sierras.

Group 3.—Corm long and cormiferous: lvs. grassy: scape tall, slender and flexuous; fls. small, in close, head-like umbels, the separate fls. waxy and narrowly tubular; perfect anthers 3, except in *B. capitata.* These species thrive in a loose, perfectly drained, loamy soil, with some humus. Hardy. The species are not readily distinguished. All are from Cent. Calif. to Wash. Known as California hyacinths.

A. *Anthers 3.*

19. **congésta,** Smith. Tall (2–3 ft.), with a globular head of purple fls.: lvs. somewhat terete, perishing: fls. 6–12, sessile or nearly so, ¾in. long; filaments 0;

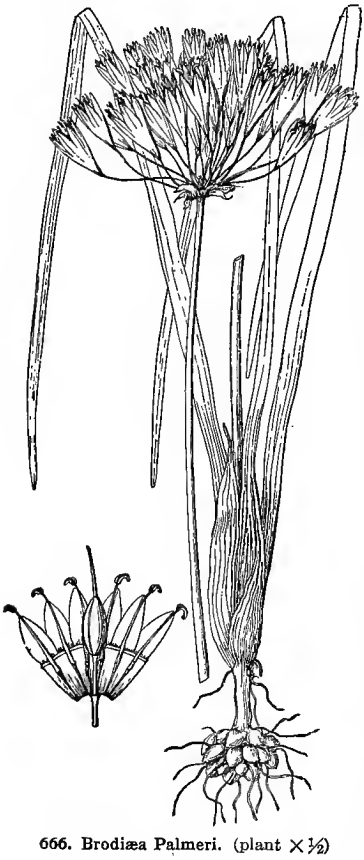
staminodia purple, 2-toothed. Calif. to Wash. G.C. III. 20:213.—Blooms late.

20. **multiflòra,** Benth. (*B. parviflòra,* Torr. & Gray). Similar to *B. congesta:* fls. 6–20, sessile or short-stalked, umbellate, ¾in. long, blue; staminodia lanceolate, entire. Calif., Ore., Utah. B.M. 5989.

AA. *Anthers 6.*

21. **capitàta,** Benth. (*Mílla capitàta,* Baker. *Dichelostémma capitàta,* Wood). Lower (1–2 ft.): lvs. narrow-linear, perishing: fls. many, in a capitate umbel, ¾in. or less long, lilac (a var. *alba*); three inner anthers winged. Calif., Utah, New Mex. B.M. 5912. G.C. III. 20:238. —Early blooming.

Group 4.—Corm as in Group 1: fls. many, in a dense, or at least a close, umbel, the tube about as long as the segms.; good anthers 6.



666. Brodiæa Palmeri. (plant ×½)

A. *Fls. essentially capitate.*

22. **Dŏŭglasii,** Wats. (*Triteleìa grandiflòra,* Lindl. *Mílla grandiflòra,* Baker). Lvs. linear: scape 1½–2 ft.; fls. few, in a close umbel, saccate as in *Brevoortia coccinea,* blue; segms. as long as the tube, the inner ones wavy; filaments winged. Ore and Wash. B. M. 6907.

23. **Hŏwellii,** Wats. (*Triteleìa Hówellii,* Greene). Fls. bell-shaped, white: differs from *B. Douglasii* in smaller fls., and segms. not more than half so long as tube. Wash. B.M. 6989.

Var. **lilăcina,** Hort. One of the handsomest of all brodieas, and a good grower: fls. porcelain-blue, suggestive of *Brevoortia coccinea.* Wash. G. C. III. 19:767; 20: 239. Gn. 46:502.—Large and strong.

AA. *Fls. in a close but rather free umbel, the pedicels usually larger than the perianth.*

24. **Pálmeri,** Wats. Fig. 666. Lvs. firm and linear: fls. many, ½in. long, the segms. about as long as tube, blue. S. Calif. G.F. 2:245 (adapted in Fig. 666).

B. coccínea, Wats.=Brevoortia.—*B. crócea,* Wats. 1 ft. or more: fls. 6–15, yellow. N. Calif.—*B. insulàris,* Greene. Like B. capitata, but more robust and larger-fld. Islands off Calif.—*B. Lémmonæ,* Wats. 1 ft.: fls. small, deep orange. N. Ariz.—*B. leptándra,* Baker. 1 ft. or less: fls. 2, purple. Calif.—*B. lilácina,* Baker. 1 ft. or less: fls. 10–15, lilac-purple. Calif.—*B. lùgens,* Baker. Like B. ixioides, but fls. saffron-color within and brown-black on tube and ribs. Calif.—*B. pulchélla,* Greene. Probably the same as B. congesta.—*B. scábra,* Baker. Like B. ixioides, but scabrous: fls. bright yellow. Calif.—*B. volùbilis,* Baker=Stropholirion.

CARL PURDY and L. H. B.

BROMÈLIA (Bromel, a Swedish botanist). *Bromeliàceæ.* Hothouse plants, grown for the stiff form and clusters of flowers.

About two dozen species of Trop. American herbs, with stiff, pineapple-like lvs., and fls. in heads or panicles; corolla 3-parted; calyx of 3 ovate-oblong sepals. Differs from Billbergia and Ananas in technical characters, particularly in the deeper-cut calyx. Less popular as stove plants than Æchmea and Billbergia. *B. bracteata* and *B. macrodontes* of trade-lists belong to Ananas. Culture as for Billbergia, which see. Monogr. by Mez, in De Candolle's Monogr. Phaner. 9.

Pínguin, Linn. PINGUIN of Jamaica. WILD PINE. Three to 4 ft. high: lvs. broad-toothed and spiny, bright green, but becoming pink and red with age: fls. reddish, pubescent, in a dense panicle, with a mealy rachis, the sepals acute: fr. as large as plums, acid. W. Indies.—Makes a good hedge in tropical countries, and the fr. yields a cooling juice.

Binòtii, Morr. Panicle lax; sepals rounded at the top: habit open and spreading. Brazil.

B. longifòlia, Rudge=Streptocalyx.—*B. tricolor,* Sandsrs. Lvs. 1½–2 ft. long, 1½–2 in. wide, the wavy margins creamy yellow except at the rose-red base, the central portion a glossy green. G.C. III. 43:261.

L. H. B.
GEORGE V. NASH.†

BROMHEÀDIA (Sir Edward F. Bromhead, English naturalist). *Orchidàceæ.* Stove orchids, terrestrial or epiphytic, non-bulbous, little known in cult., comprising two species from the East Indian–Malayan region.

Leaves distichous, rigid, often fleshy: fls. showy, white and orange, the parts narrow and pointed; lip 3-lobed, narrow. Prop. by division or offsets after flowering. **B. Finlaysoniàna,** Reichb. (*B. palùstris,* Lindl. *Grammatophýllum Finlaysoniànum,* Lindl.). Root of stout and fleshy fibers: st. 3–8 ft., with sheathing scales below and a few oblong thick or fleshy lvs. at the middle and elongated scaly peduncle at the top: fls. white, fragrant, the parts 1½ in. long, oblong-acuminate and nearly equal, spreading; lip oblong, 3-lobed, white outside and purple-lined inside, the middle lobe rounded and yellow at center. B.M. 4001.

BROMPTON STOCK: *Matthiola.*

BRÒMUS (ancient Greek name for the oat). *Gramineæ.* BROME-GRASS. Annual or perennial grasses with large, usually awned spikelets in panicles.

Spikelets several-fld.; lemmas convex or keeled, 5–9-nerved, usually 2-toothed at apex and awned from between the teeth, sometimes awnless, the awn usually straight.—Species about 100, mostly in the north temperate zone.

The genus contains a few forage grasses and several annual species that have been intro. into the U. S., especially on the Pacific coast, where they have become troublesome weeds. Among the weedy annual species may be mentioned *B. secalinus,* Linn., chess or cheat, with smooth sheaths, drooping panicles of ovate short-awned spikelets, the lemmas convex and smooth; *B. commutatus,* Schrad., resembling the preceding but the sheaths hairy; *B. mollis,* Linn. Resembles chess, from which it differs by its hairiness and more erect panicle; *B. villosus,* Forsk., with large few-fld. spikelets, the awns about 2 in. long; *B. tectorum,* Linn., delicate, slender spikelets in drooping panicles the awns 6–7 lines long; *B. rubens,* Linn., with erect compact panicles of purple spikelets, the awn 9–11 lines long. The last 3 are especially abundant in Calif. Cheat is used for hay in Ore.

A. *Plants perennial, producing rootstocks.*

inérmis, Leyss. AWNLESS BROME-GRASS. Erect, 2–4 ft.: panicle narrow, the branches ascending or spreading in fl.; spikelets about 1 in., the lemmas mucronate or short-awned. Intro. from Eu. Gn. 25, p. 429. Dept. of Agric., Div. of Agrost., 7:298.—Used as a pasture and meadow grass in the northwestern states. Especially valuable in semi-arid regions.

AA. *Plants annual or biennial.*

B. *Spikelets awnless or nearly so.*

brizæfórmis, Fisch. & Mey. One to 2 ft.: panicle 2–6 in., one-sided, nodding; spikelets oblong-ovate, strongly flattened, as much as 1 in. long, 5 lines wide. Eu. Dept. of Agric., Div. of Agrost., 7:298.—A handsome ornamental.

unioloìdes, H B K. (*B. Schràderi,* Kunth). Fig. 667. RESCUE-GRASS. SCHRADER'S BROME-GRASS. Two to 3 ft.: sheaths pilose; blades narrow, scabrous: panicle erect, open or narrow, the branches ascending; spikelets 1 in. long, compressed, the lemmas keeled, strongly nerved, acuminate, glabrous or scabrous. Andes. Dept. of Agric., Div. of Agrost., 7:299; ibid, Circ. 26:1.—Grown in the southern states as a forage grass.

BB. *Spikelets long-awned.*

macróstachys, Linn. One to 2 ft.: panicle narrow, compact, consisting of a few large spikes ¾–1 in. long; awns spreading or recurved, ½in. long. Eu.—Sometimes cult. for ornament.

madritènsis, Linn. Fig. 668. One to 2 ft., tufted: panicle erect, 2–4 in., oblong-ovoid, contracted; glumes and lemmas narrow, the latter 7–9 lines long; awn straight or somewhat curved, 8–11 lines long. Eu.—Sometimes cult. for ornament.

B. praténsis=Festuca elatior.

A. S. HITCHCOCK.

667. Bromus unioloides. (×½)

BROOM: *Cytisus* and *Genista.*

BROOM-CORN. Brooms are made of the rays or peduncles of the flower-cluster of *Andropogon Sorghum* (*Sorghum vulgare*), the species which in other forms is known as sorghum, kafir, and Guinea corn. For cultivation of broom-corn, see Cyclo. Amer. Agric., II, 216.

BRÓSIMUM (Greek, *edible*). *Moràceæ.* A genus of 8 species of large trees of Trop. Amer., yielding edible fr.: fls. monœcious, or rarely dicœcious, inside or on the outside of a fig-like receptacle. *B. Alicástrum,* Swartz, is the bread-nut of Jamaica, but it is not grown within the U. S., except in most of the botanic gardens. It bears round yellow fr., about an inch in diam., containing a single large seed, which is edible after roasting. The tree has shining lance-elliptic entire lvs. Prop. by cuttings of young wood in a bell-jar with bottom heat.

BROUGHTÒNIA (named in honor of an English botanist, Arthur Broughton). *Orchidàceæ.* Epiphytic orchids, requiring stove conditions.

Pseudobulbs, 1- or 2-lvd., ovoid or globose: infl. terminal, simple or somewhat branched; sepals and petals similar, somewhat spreading, the latter a little the broader; lip sessile on the base of the column or sometimes a little adnate, lateral lobes inclosing the column, middle lobe spreading; ovary extended into a long cavity; pollina 4, waxy.—A West Indian genus of 2 or 3 species. Sometimes united with Epidendrum.

sanguínea, R. Br. Pseudobulbs up to 2 in. long, 2-lvd.: lvs. 2–4 in. long, leathery, linear-oblong: racemes of 5–10 fls. about 1½ in. across and of a crimson-purple; sepals lanceolate, acute; petals oval-oblong; lip nearly orbicular, denticulate on the margin. Jamaica. B.M. 3076, 3536 (as *B. coccinea*).

GEORGE V. NASH.

BROUSSONÈTIA (after T. N. V. Broussonet, a French naturalist). *Moràceæ.* Ornamental trees or shrubs, grown chiefly for their large handsome foliage.

Leaves alternate, petioled, serrate, undivided or lobed: fls. dicœcious, apetalous, the staminate in cylindrical, nodding catkins, with 4-parted calyx and 4 stamens, the pistillate in globular heads with a tubular perianth including the stalked ovary; stigma filiform: collective fr., a dense globose head consisting of the persistent perianths and bracts with numerous small 1-seeded drupelets protruding at maturity and orange red.—Three species in E. Asia, and there often cult., the bark being used for paper-making.

These are deciduous trees with wide-spreading branches, under culture often shrubby, with rather inconspicuous greenish white flowers. *B. papyrifera,* the hardier of the two species in cultivation, is fairly hardy as far as north New York. It is usually a small tree with a rather low wide-spreading head and may be used in cities in situations in which small shade trees are wanted, as it stands heat and dust well. It is not particular as to the soil.

Propagation is by seeds, sown after maturity or in spring, by greenwood cuttings under glass, or by cuttings of ripened wood, kept in colder climates during the winter in the greenhouse; also by root-cuttings with slight bottom heat and layers. The varieties are also sometimes budded in summer or grafted in early spring on the roots of the type in the greenhouse. Known as paper mulberries.

papyrífera, Vent. (*Mòrus papyrífera,* Linn.). Tree, 30–50 ft., with thick, pubescent branches: lvs. long-petioled, usually cordate-ovate, acuminate, coarsely dentate, often deeply lobed, especially on younger plants, rough above, pubescent beneath, 3–8 in. long: fr.-heads ¾in. across, red. May. China, Japan. B.M. 2358. S.I.F. 1:38. Var. **cucullàta,** Ser. (*B. naviculàris,* Lodd.). Lvs. small, concave and curled upward. G. W. 6:601. Var. **laciniàta,** Ser. (var. *dissécta,* Hort., var. *Billárdii,* Hemsl.). Lvs. finely dissected into very narrow lobes, often reduced to the nerves and only at the end with a small lanceolate or ovate-lanceolate lft. R.H. 1878, pp. 374, 375. Gn. 15, p. 53.—Very distinct form, low and shrubby, more tender than the type. Var. **macrophýlla,** Ser. Lvs. large, usually undivided. Var. **leucocárpa,** Audib. Fr. white.

668. Bromus madritensis. (×¼)

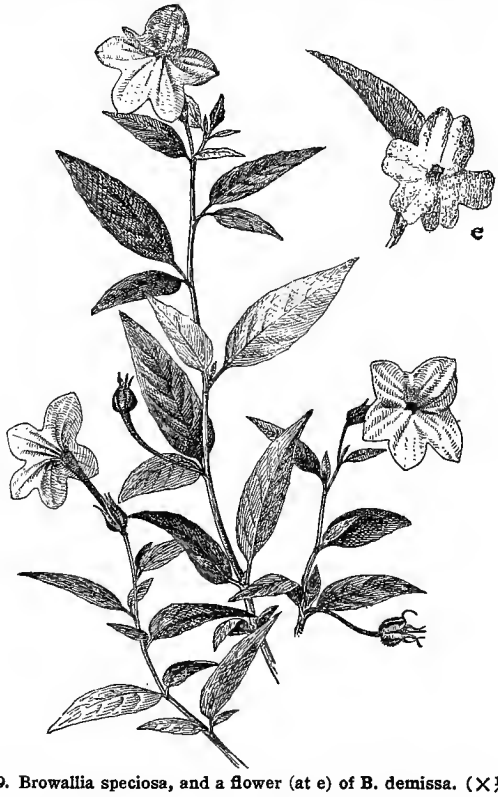
Kazinòki, Sieb. (*B. Siebóldii,* Blume. *B. Kaémpferi,* Hort.). Branches slender, glabrous at length: lvs. short-petioled, ovate or ovate-oblong, nearly glabrous, only somewhat rough above, entire or 2–3-lobed, 2–8 in. long: fr.-head less than ½in. diam.

China, Japan. I. T. 2:45.—This species is more tender than the former. It is cult. sometimes as *B. Kaempferi*, while the true *B. Kaempferi*, Sieb., with the lvs. resembling in shape those of *B. Kazinoki*, but much smaller and pubescent, and with very small fr.-heads, seems not be in cult. ALFRED REHDER.

BROWÀLLIA (after John Browall, Bishop of Abo, Sweden). *Solanàceæ*. Mostly blue-flowered greenhouse and garden herbs.

A genus of about 6 S. American annuals, with abundant blue, violet or white fls. which are solitary and axillary, or in more or less 1-sided racemes; corolla-tube 15-nerved, straight, which distinguishes it from Streptosolen, in which the corolla is twisted.

The seeds may be sown in the open border, but for the sake of the earlier bloom it is better to start them indoors in early spring and transplant into the open about May 15, where they will bloom profusely all through our hot, dry summers, and until frost. They can be grown in poorer soil than most half-hardy annuals, and make excellent bedding-plants. They are also used for winter decoration, the seeds being sown in midsummer, earlier or later according to the size of the specimens desired. They should be placed near the glass and frequently stopped, in order to produce compact plants. Large specimens are excellent for cutting, and small potted plants should be grown more commonly by florists for home decoration at Christmas. It is even possible to lift flowering plants from the open before the first frost of autumn and pot them for conservatory decoration, although the flowers are likely to become successively smaller. Blue flowers are rare in winter, and browallias are especially desirable for their profuse bloom all through winter and early spring. The flowers are, however, likely to fade, especially the purple ones. In pots under trees, *B. speciosa* makes an excellent summer plant.



669. Browallia speciosa, and a flower (at e) of B. demissa. (×½)

In the names of the early species, Linnæus commemorated the course of his acquaintanceship with Browall: *elata*, reflecting the exalted character of their early intimacy; *demissa*, its rupture; and *alienata*, the permanent estrangement of the two men.

A. *Corolla-segms. long, acute or acuminate: corolla-tube at least 1 in. long.*

speciòsa, Hook. Fig. 669. Lvs. sometimes opposite, sometimes alternate: fls. much larger than in *B. grandiflora*, all solitary, axillary; peduncle shorter than the lvs.; corolla-tube thrice as long as the calyx, and abruptly swollen at the top beneath the limb; limb of 5 ovate, striated, dark purple segms., pale lilac beneath. Colombia. B.M. 4339. P.M. 16:290.—There are blue-, violet- and white-fld. varieties. Var. **màjor**, Hort., has violet fls. 2 in. across. R.B. 20:240. **B. gigantèa**, Hort., is a florists' variety, with very deep blue fls. and long-blooming habit. Intro. into American trade in 1899.

AA. *Corolla-segms. short, 2-lobed or notched: corolla ¾in. long or less.*

B. *Upper lvs. not stalked: fls. all in loose racemes; calyx not hairy.*

grandiflòra, Graham (*B. Roézlii*, Hort.). St. and lvs. glabrous, or in the upper part of the plant minutely clammy-puberulent: lvs. ovate, the lower petioled: calyx-teeth oblong, somewhat obtuse, equal, scarcely shorter than the tube, spreading: corolla white or pale blue, the limb wider than in *B. demissa*. Peru. B.M. 3069.—In *B. Roezlii*, said to be from the Rocky Mts., some fls. are white, some pale blue. The name is unknown in N. American botanical literature. No dark blue or violet-colored forms are advertised.

BB. *Upper lvs. stalked: fls. solitary and axillary below, racemose above.*

c. *Calyx hairy.*

demíssa, Linn. (*B. elàta*, Linn.). Fig. 669. St. and lvs. pubescent or glabrous: lvs. ovate, with longer stalks than in *B. grandiflora*: calyx-teeth acute, unequal, much shorter than the corolla-tube. The lvs. are variable, cuneate, rotund, or rarely cordate. S. Amer. B.M. 34; 1136. The following are now referred to the above: *B. americana*, *B. elata*, *B. elongata*, *B. nervosa*. This species is the commonest, and is usually known as *B. elata*. Blue, violet, white and dwarf forms are cult.

cc. *Calyx sticky or clammy.*

viscòsa, HBK. (*B. pulchélla* and *B. Czerniakowskiàna*, Hort.). Plant viscous-pubescent: lvs. short-petioled, ovate, rough-hairy on both sides: pedicels a little shorter than the calyx: calyx-teeth very clammy, oblong, shorter than the corolla-tube. The lvs. are similar to *B. demissa*, but the habit is stiffer and the fls. more numerous. The calyx-teeth spread less than in *B. grandiflora*. S. Amer.

B. americàna, Linn., is considered by some a separate species from the above, but in Germany, where most seeds of annual fls. are grown, it is used by Siebert & Voss (in Vilmorin's Blumengärtnerei) to include B. demissa, B. elata and other forms.—*B. Jàmesonii*, Benth.=Streptosolen Jamesonii.—*B. pulchélla*, Hort., is likely to be either B. grandiflora or B. viscosa. WILHELM MILLER.

N. TAYLOR.†

BROWNEA (Patrick Browne wrote a history of Jamaica). Sometimes written *Brownæa*. (*Hermesias*, Loefl.). *Leguminòsæ*. A group of 10 small evergreen trees of Trop. Amer., allied to Amherstia and Bauhinia but little known in the American trade. Lvs. alternate and pinnate: fls. showy, red, in dense terminal or axillary clusters. Cult. in hothouses. **B. Arìza**, Benth. (*B. princeps*, Lind.) has drooping heads of scarlet fls. I.H. 42:38. **B. grándiceps**, Jacq. Fig. 670. Fls. red, in capitate spikes: lfts about 12 pairs, lance-oblong. S. Amer. B.M. 4859. G.M. 31:115. **B. Ròsa-de-Mónte**, Berger. Fls. scarlet, in dense heads: lfts. 2–3 pairs, oval, acuminate. S. Amer. N. TAYLOR.†

BRUCKENTHÁLIA (after S. von Bruckenthal, an Austrian nobleman). *Ericàceæ.* Ornamental shrub, chiefly grown for its profusely produced small spikes of pink flowers.

Leaves linear, whorled: fls. in short racemes; calyx campanulate, 4-lobed; corolla campanulate with 4 triangular lobes; stamens 8, included, connate at the base; disk rudimentary; caps. subglobose, 4-celled, loculicid, many-seeded.—One species in S. E. Eu. and Asia Minor. Very closely related to Erica, but differs chiefly in the calyx being lobed only to the middle, not 4-parted, in the rudimentary disk and the connate stamens.

670. Brownea grandiceps. (×1-12)

This is a low evergreen, heath-like shrub forming large tufts, with needle-shaped small leaves and small rosy pink nodding flowers in short terminal racemes, produced in great profusion. Perfectly hardy North and requiring the same treatment as hardy ericas; a pretty little plant for rockeries. Propagation is usually by seeds which are freely produced in cultivation and treated like-those of erica; also by cuttings.

spiculifòlia, Reichb. (*Erìca spiculifòlia,* Salisb. *B. spiculiflòra,* Benth.). Tufted shrub, 5–8 in. high: lvs. about ⅛in. long: fls. ⅛in. long; anthers obtuse, 2-lobed at the apex, style exserted. June, July. B.M. 8148.

ALFRED REHDER.

BRUGMÁNSIA: *Datura.*

BRUNÉLLA (probably from old German *breune* or *braune,* quinsy, which it was thought to cure). Often written *Prunella,* which was the spelling used by Linnæus. *Brunella* is pre-Linnæan. *Labiàtæ.* Low-growing hardy herbaceous perennials.

Flowers usually violet or purple, produced all summer on heads an inch or more high or in bracted spikes; calyx reticulate about 10-nerved and 2-lipped, which distinguishes it from the closely related Physostegia, in which the calyx is almost regular.

They are best suited for the rockery and slightly shaded parts of the border, succeeding in almost any soil that is not excessively dry.

vulgàris, Linn. SELF-HEAL. HEAL-ALL. Lvs. ovate-oblong, entire or toothed, usually pubescent: corolla violet or purple, rarely white, ½–¾in. long, not twice as long as the purplish calyx. Amer., Eu., Asia.—One of the most cosmopolitan of all plants, being too common in the wild to be cult. A form with variegated lvs. is rarely found wild. Herb considered astringent and vulnerary. Var. **laciniàta,** Hort., not Linn. Lvs. much cut and torn: fls. as in the type.

grandiflòra, Jacq. (*B. pyrenàica,* Phillipe). Lvs. often toothed, especially at the base: corolla over 1 in. long, more than twice as long as the calyx. Eu. B.M. 337.—Perhaps the best of the garden kinds. Var. **álba,** Hort. Fls. pure white.

Webbiàna, Hort. Lvs. shorter than in *B. grandiflora,* and not so pointed: fls. very freely produced, more than twice as long as the calyx, bright purple. June–Sept.

N. TAYLOR.†

BRUNFÉLSIA (Otto Brunfels, physician and botanist of the sixteenth century). *Franciscea. Solanàceæ.* Trees and shrubs, a few of which are grown in warm glasshouses.

Leaves entire, oblong, often shining: fls. in terminal cymes or clusters, or solitary, large and showy, sometimes fragrant; corolla with 5 rounded and nearly equal spreading lobes (or 2 of them a little more united); stamens 4, in the throat of the corolla, the anthers all alike: fr. berry-like.—Species above 20, in Cent. and S. Amer. and W. Indies.

Brunfelsias are usually winter-flowering plants. The wood must be well ripened before flowering begins. Grow in a rich open compost, and feed liberally when well rooted. They need a night temperature of 50°. They bloom best when pot-bound. Propagated by cuttings from the new growth in spring, or from pieces of the ripe wood in autumn inserted in very sandy soil and peat and kept close and shaded until rooted. The plants are of easy culture when the simple requirements are understood. Under glass, the bloom begins usually in October and November. They are showy open-air plants in Florida and southern California.

A. *Fls. violet or bluish, sometimes fading to white.*

calycìna, Benth. (*Franciscea calycìna,* Hook. *F. pauciflòra,* Benth. *F. confertiflòra,* Moore. *Beslèria inodòra,* Vellozi). Habit erect or spreading, branching freely from the base upwards: lvs. shortly petiolate, numerous, glabrous or nearly so, 3–4 in. long, elliptic or elliptic-ovate, acute, rich dark livid green above, pale green below: fls. rich dark purple in dense terminal or axillary cymes; pedicels an inch long; limb salver-shaped, with slightly wavy margins; calyx ¾–1 in. long, tubular, light green. Brazil. B.M. 4583.—Extremely variable in the size of the fls. and lvs. Some of the most distinct forms have been described as species by various botanists. All have fls. of some shade of purple and are here included as varieties. The following are well-marked forms in cult.:

Var. **exímia** (*Franciscea exímia,* Scheidw.). A fine free-flowering variety intermediate in size between the type and var. *macrantha* and characterized by the long slender slightly curved and hairy calyx, which is about 1¼ in. long: fls. rich purple on first-opening, but soon fading to almost pure white, about 1½ in. diam.; calyx rather long for the genus, tube extending to three-fourths its length: whole plant slightly downy. B.M. 4790. F.S. 10:1037.

Var. **floribúnda** (*B. floribúnda,* Hort.). A dwarf floriferous shrub of free-branching habit and glabrous in all parts: lvs. 2–4 in. long, elliptic, rich dark livid green color, glabrous, and prominently veined on the under sides: fls. rich violet, with small white eye; limb flat or nearly so; calyx ⅝in. long, elliptic in outline; pedicels stout, ½in. long.—Largely grown by European nurserymen in recent years. A pretty and desirable form, as it flowers rather early in the year without any extra heat.

Var. **macrántha** (*B. macrántha,* Lem. *B. grandiflòra,* Don. *B. Lindeniàna,* Nichols.). Fig. 671. A magnificent form of strong and vigorous habit, with rich dark green lvs. often as much as 8 in. long and 2½ in. broad, glabrous or nearly so in all parts, except the upper part of the corolla-tube: fls. in dense axillary or terminal cymes in the axils of all the upper lvs., rich deep purple in color, with prominent ring of lavender-blue color surrounding the white eye at the mouth of the tube; calyx, 1 in. long, bright green; corolla 2½–3 in. diam.—One of the finest and most floriferous shrubs for a warm greenhouse or subtropical country, of

extremely easy cult., and readily trained into fine specimens. Readily conforms to pot culture. Should be kept slightly on the dry side during the winter, but not enough to cause it to lose the lvs.

ramosíssima, Benth. Lvs. oblong to nearly lanceolate, acuminate or obtuse, glabrous or rarely slightly hairy above and hairy or villous beneath: fls. large, in lax cymes, deep violet-purple, the corolla-tube twice longer than the calyx.—One of the best, with luxuriant foliage; may be grown cooler in winter than the other species. Probably a form of *B. calycina.*

Hopeàna, Benth. (*Franciscea Hopeàna,* Hook. *F. uniflòra,* Pohl). A slender twiggy free-branching shrub: lvs. lanceolate-oblong, thin in texture, rich dark green, paler beneath: fls. small but freely produced, solitary or in pairs all along the leafy growths; limb light violet-blue on first opening, fading to almost pure white with age; tube very slender, curved upwards, nearly white, 1 in. long; calyx ¾in. long, teeth obtuse. Brazil. W. Indies. B.M. 2829. L.B.C. 14:1332.

latifòlia, Benth. (*Franciscea latifòlia,* Hook.). Habit dwarf with slender spreading branches: lvs. elliptic, 2–4 in. long, acute or obtuse, glabrous above, slightly pubescent beneath: fls. in terminal clusters or short axillary, few-fld. cymes; corolla 1½ in. diam., pale violet, with white center, changing in a day or so to white, sweetly scented; tube 1½ in. long, slender, slightly curved; calyx erect, campanulate, ½in. long, teeth acute. Trop. Amer. B.M. 3907.

AA. *Fls. white or yellow.*

americàna, Linn. Habit dwarf, branches slender: lvs. glabrous or nearly so; lamina elliptic-ovate, acute; petiole ½–1 in. long, stout: fls. solitary and axillary, or in terminal few-fld. clusters, pure white shading with age to pure yellow and sweetly scented, especially at night; petals obtuse; calyx green, campanulate teeth spreading, nearly equaling the length of the tube. Trop. Amer. B.M. 393.—Of very easy cult., and thriving and seeding freely under the conditions of an ordinary greenhouse. In Fla., grows 4–6 ft. high; the very fragrant fls. are much prized.

Var. **pubéscens** (*A. fàllax,* Hort.). Resembles the type, but hairy in all its parts, and rather more floriferous.

undulàta, Swartz. A strong-growing evergreen shrub or small tree, reaching to 20 ft. in its native habitat and flowering freely when quite small: lvs. ovate-lanceolate, margins slightly wavy, light green in color, acute, variable in size up to 7 in. long and 2 in. wide when vigorous; apex acute or obtuse; petiole ¼–½ in. long: fls. on the upper parts of the sts. solitary or in pairs in the axils of most of the terminal lvs. forming terminal clusters; calyx cyme green ½–¾in. long, campanulate; corolla white changing to creamy white with age; lobes broadly ovate or orbicular in outline and with beautiful wavy margins. Jamaica. B. M. 8422.—A magnificent free-flowering species and a great acquisition to any garden. Requires subtropical conditions.

671. Brunfelsia calycina var. macrantha. (×⅓)

jamaicénsis, Griseb. (*B. nítida* var. *jamaicénsis,* Hook.). An erect shrub or small tree, sparsely branched in the young state: sts. woody, with the lvs. more or less tufted at the ends of each year's growths: lvs. elliptic or lanceolate, up to 7 in. long, but often small and borne on short lateral tufted growths, glabrous or nearly so; petiole very short: fls. crowded on the apex of the current year's growth, solitary (occasionally in pairs) and axillary; pedicels ¼–½in. long, slender, erect or spreading; calyx erect, ⅓in. long, campanulate teeth spreading, acute; corolla erect, white, changing with age to primrose-yellow. W. Indies. B.M. 4287.—A very fine species for the warmer parts of the S., but a somewhat shy-flowering plant unless the growth is thoroughly well ripened up. There is a general resemblance between this species and *B. nitida* and *B. undulata* and it is possible that they are forms of one polymorphic species.

L. H. B.
C. P. Raffill.

BRUNSDÓNNA. A cross between *Brunsvigia* and *Amaryllis Belladonna* has recently been given the garden name *Brunsdonna Sanderæ alba;* it has the umbel resembling typical *A. Belladonna,* and one-sided rather than globular: fls. white. See *Amaryllis Belladonna* var. *Parkeri,* which is a similar cross.

BRUNSVÍGIA (after the Duke of Brunswick). *Amaryllidàceæ.* Tender summer- or autumn-flowering bulbs.

Umbels of large numerous brick-red fls.; corolla funnelformed, 6-parted, deciduous, its segms. nearly equal, recurved at the tip.—Species 9. S. Afr.

The bulbs must be thoroughly rested from the time the leaves fade until the scape appears. Brunsvigias are hard to flower. They require rich, sandy soil, plenty of heat and sunlight. When growing, give water and liquid manure freely. They propagate by offsets. For fuller instructions, see *Amaryllis.*

A. *Lvs. strap-shaped.*

Josephìnæ, Ker. Bulb 5–6 in. thick: lvs. 8–10, strap-shaped, glaucous or greenish, thick, closely ribbed, 2–3 ft. long, 1½–2 in. broad: scape 1 in. thick, 1½ ft. long; fls. 20–30, rarely 50–60, in an umbel; pedicels ½–1 ft. long: caps. smaller than in *B. gigantea,* less conical and less strongly angled. B.M. 2578. F.S. 4:322.—Named after the Empress Josephine, who purchased the original bulb after it flowered at Malmaison.

AA. *Lvs. tongue-shaped.*

gigantèa, Heist. (*Amarýllis gigantèa,* Van Marum. *A. orientàlis,* Ecklon). Bulb very large: lvs. about 4, tongue-shaped, closely ribbed, 3–5 in. broad, usually under 1 ft. long: scape red or green, a finger's thickness; fls. 20–30 in an umbel, paler than in *B. gigantea,* and less numerous; pedicels stout, strongly ribbed, 4–6 in. long. B.M. 1619 (as *B. multiflora*).

B. falcàta, Ker=Ammocharis falcata.—*B. magnífica,* Lind. Fls. 20–25 in a cluster; corolla short; the segms. white, with medium stripe of red or purplish red: lvs. 1–2 ft. long, 3–3½ in. wide, recumbent.—Thought by Baker to be Crinum Forbesianum or near that species.

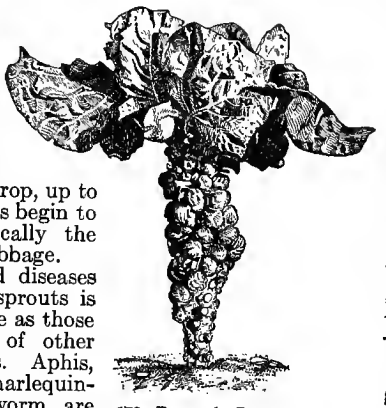
N. Taylor.†

BRUSSELS SPROUTS. Fig. 672. A form of the cabbage tribe, grown for the globular buds or "sprouts" produced along the stout upright stem.

The garden varieties of brussels sprouts represent one of the many interesting variations that have taken place in the cabbage family. This plant, while in its seedling stage and during its early life, closely resembles the ordinary cabbage, but later in its development the axillary buds, instead of remaining dormant as is the case with the common cabbage, develop into miniature heads similar in their make-up to an ordinary head of cabbage but very small.

The soil to which the sprout is adapted is, in general, the same as that for late cabbage; in fact, the plant is

always grown in conditions similar to those chosen for late cauliflower or late cabbage, and its range of adaptation is much the same as that of autumn cabbage. The fertilizing of the crop should be the same, in general, as for autumn cabbage. The plants should be set so as to allow them sufficient room for full development, preferably in check-rows 30 to 36 inches apart each way. Young seedlings should be ready for planting in the latitude of New York from June 20 to July 10. The cultivation of the crop, up to the time the sprouts begin to develop, is practically the same as that for cabbage.



672. Brussels Sprouts.

The enemies and diseases to which brussels sprouts is subject are the same as those of the fall crops of other cabbage-like plants. Aphis, green-worm, the harlequin-bug and the cutworm are probably the most annoying of the insect pests, while the rots, damping-off fungus and the mildew are more or less troublesome.

Before the sprouts are ready for harvest, the lower leaves of the plants are broken away in order to facilitate the cutting of the miniature heads or sprouts; this is done by means of a sharp short-bladed knife, used to separate them from the stalk of the plant. In sections in which the plant can remain in the open during the winter, two or three cuttings are made. The first sprouts develop in the axils of the leaves nearest the ground, and as the stalk of the plant elongates and more leaves are added, a succession of sprouts develop. The first cutting is confined, therefore, to the older and more fully developed sprouts. When the miniature heads have attained the size of ½ to 1 inch in diameter, the cutting begins and is repeated at intervals depending upon the development of the sprouts. In regions in which it is not safe to allow the plants to remain in the open during the winter, a small supply for home use or for local market may be stored in a vegetable-cellar or storage-pit, the plants being lifted with earth adhering to the roots and planted in sand that is kept somewhat moist during the storage period. Under these conditions, the sprouts will remain in good condition for several weeks and successive harvests can be made the same as when the plants are standing in the open.

The hand labor involved in gathering the sprouts and preparing them for market is the chief deterrent to the extensive cultivation of this crop. It is only in regions in which mild winter conditions prevail and in which labor is available to harvest and assort the sprouts that the industry thrives on a commercial scale. After the sprouts have been cut and placed in suitable receptacles, they are carried to a packing-house where each head is trimmed by removing the outer leaves. The trimmed heads are then placed in berry boxes holding one quart, those for the top layer being selected for uniformity in size and arranged so as to give a finished appearance to the receptacle.

Several varieties of brussels sprouts are offered by the trade, but there is only one general type, the chief difference being in the length of the stalk of the plant itself and the manner in which the sprouts are distributed along the stalk. This plant, although a popular vegetable in England and on the Continent, is sparingly cultivated in the United States, a few centers only giving attention to it as a commercial crop. Parts of Long Island, in New York, are well known for brussels sprouts production.

L. C. Corbett.

BRYÂNTHUS (Greek, *bryon*, moss, and *anthos*, flower: growing among mosses). *Ericàceæ*. Heath-like low shrub with pretty pink flowers, suitable for rockeries, but not yet in cultivation.

Leaves evergreen, linear, remotely denticulate: calyx 4-parted; corolla rotate, 4-parted; stamens 8: caps. subglobose, 4-valved.—One species on Kamtchatka and Behrings Isls. The genus Phyllodoce has been referred by several botanists to Bryanthus, but it differs considerably in its urceolate or campanulate 5-lobed corolla, 10 stamens, 5-valved caps. and solitary or umbellate fls.

This prostrate evergreen shrub has small needle-shaped leaves and small rosy pink flowers in peduncled, slender, 3–10-flowered racemes. Bryanthus will probably require the same treatment as Chiogenes, Loiseleuria and Phyllodoce. The only species is **B. Gmelînii**, Don. For illustration, see Pallas, Fl. Ross. 2:74 (as *Andromeda Bryanthus*).

B. Brèweri, Gray=Phyllodoce Breweri.—*B. empetriformis*, Gray =Phyllodoce empetriformis.—*B. eréctus*, Lindl.=Phyllodoce erecta. —*B. glanduliflòrus*, Gray=Phyllodoce glanduliflorus.—*B. taxifòlius*, Gray=Phyllodoce taxifolia.

Alfred Rehder.

BRYÒNIA (Greek, *to sprout*, referring to the annual growth from the tuber). *Cucurbitàceæ*. Herbaceous perennial climbers.

A genus of 12 species of perennial cucurbits, native of Eu. and W. Asia. They are herbaceous from a tuberous root, with staminate fls. in racemes, while Bryonopsis is an annual plant, with the staminate fls. in fascicles. All species of Bryonia are diœcious except *B. alba*. Bryonopsis is monœcious. See Cogniaux, in DC. Mon. Phan. 2:469.

A. *Fls. diœcious; stigmas rough: fr. red.*

diòica, Jacq. Bryony. Height 6–12 ft.: root long, fleshy, branching, white, a finger's thickness: lvs. ovate or roundish in outline, 5-lobed, margin wavy-toothed, rough with callous points, paler beneath: pistillate fls. greenish white, corymbose, short-peduncled.—Common in England and in Cent. and S. Eu., rarer in W. Asia and N. Afr. Not usually sold in Amer., but a common plant along English highways and cult. in American botanic gardens. It grows rapidly over hedges and fences. Root of this and of *B. alba* are employed principally as a hydragogue-cathartic. The fresh, bruised root applied to the skin causes vesication.

AA. *Fls. monœcious; stigmas smooth: fr. black.*

âlba, Linn. Height 6–12 ft.: roots thick, tuberculate, yellowish outside, white within: lvs. long-petioled: pistillate fls. in long-peduncled racemose corymbs. Eu., Caucasus, Persia.

B. laciniòsa, Linn.=Bryonopsis laciniosa.

Wilhelm Miller.

BRYONÓPSIS (Greek, *Bryony-like*). *Cucurbitàceæ*. A genus of two species of annual climbers. Consult *Bryonia* for generic differences.

laciniòsa, Naudin (*Bryònia laciniòsa*, Linn.). Lvs. deeply 5-lobed, rough, light green above, paler beneath; segms. oblong-lanceolate, acuminate. serrate: fls. monœcious, fascicled or solitary, yellow: fr. about the size of a cherry, spherical, green, with pretty white markings. Asia, Afr., Austral. F.S. 12:1202. Var. **erythrocârpa**, Naudin (*B. erythrocàrpa*, Naudin). Has red fr. with white marks. I.H. 12:431. F.S. 21:2237. Gn. 6, p. 193.—A warmhouse plant, rarely grown in pots and trained to rafters. Prop. by seeds.

Wilhelm Miller.

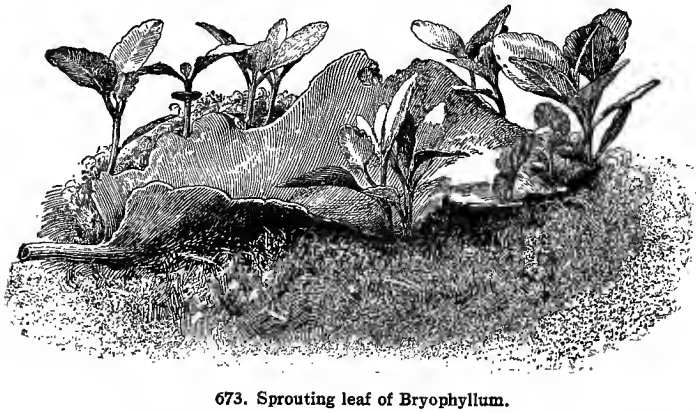
BRYOPHÝLLUM (Greek, *sprouting leaf*). *Crassulàceæ*. A small genus of succulent plants in the same order with stonecrops, hen-and-chickens, cotyledon and echeveria, grown to some extent as flowering plants but more especially as a foliage novelty.

Root-system fibrous and very abundant: sts. upright,

simple or sometimes branching toward the base, of a thick soft tissue over a woody cylindrical core: lvs. opposite, petioled, simple or pinnately compound, succulent: infl. cymose or paniculate; fls. nodding; sepals 4, united into an inflated calyx which incloses the lower half or more of the corolla; corolla cylindrical, ending in 4 petal tips; stamens 8; ovaries 4, separate or more or less united below.

The members of this genus may readily be distinguished from related genera by the "sprouting" habit of their leaves as indicated by the generic name. If a leaf is removed from a plant and placed in a warm moist place, young plants will very soon appear in the notches around its border. This is the simplest method of propagation and is usually accomplished by placing the leaf flat on the wet sand of a growing-bench, in a warm, sunny exposure. Tiny buds will soon appear in the notches and these are followed by numerous fine roots. See Fig. 673. When the small plants have attained a size sufficiently large to be handled, they may be removed from the parent leaf and potted. This method may be employed in growing-houses at any season. Plants are also readily produced from stem-cuttings rooted in sand, or from seed. Seeds retain their vitality more than a year when kept dry. The best plants are to be grown by using rather rich loose, well-drained soil, with plenty of light, heat and moisture. However, they are very tenacious of life and will survive with a minimum of water and a low, but not freezing, temperature. They grow luxuriantly out-of-doors during the summer months but must be housed during the frost period. Useful in various botanical demonstrations.

pinnàtum, Kurz (*B. calycìnum,* Salisb.). Figs. 673–4. Height 2–4 ft.: lvs. opposite, fleshy, becoming leathery with age, earlier ones simple, ovate, with cordate or rounded base, later ones pinnate and then of 3–5 short-stalked lfts., the rachis and petiole with a narrow groove on the upper side, margin crenately doubly-serrate, light green becoming purplish along the veins toward maturity, margin purple as are also the petioles and young st.-growths: fls. pendulous, in terminal panicles; calyx much inflated, purplish green with lighter dots, 1½ in. long; corolla greenish white with purple-tinted, spreading acute tips. Tropics of both hemispheres. B.M. 1409. L.B.C. 9:877. G.C. III. 41:422. J.H. III. 46:205.



673. Sprouting leaf of Bryophyllum.

R.B. 24:125. R.H. 1900, p. 362. V. 3:117; 4:113; 7:340.—Said to be used in India as a diuretic.

crenàtum, Baker. Less robust in habit of growth than the preceding: height 2–3 ft.: lvs. very fleshy, simple, 1–3 in. long, becoming smaller upward on the st., ovate with rounded or cordate base, in the latter case strongly crested auriculate, margin coarsely crenate to dentate, bright green with purplish pink margin and strongly bluish glaucous when young as are also the petioles and sts.; petioles not grooved on the upper side: fls. nodding, in terminal, open, corymbose cymes; calyx membranaceous, inflated, ⅜in. long, pink; corolla ¾in. long, ending in 4 rounded segms., red. Madagascar. B.M. 7856. G.C. III. 33:59; 41:419. G.W. 10, p. 396; 6, p. 495. R.H. 1900, pp. 175, 176, 362.

B. proliferum, Bowie. Occasionally met with, is much more robust in growth, reaching 12 ft. in height: st. 4-angled in new growth, becoming cylindrical later: lvs. pinnatifid to pinnate, the base of the pinnæ very much thickened, blade much contorted and margin finely crenate, rachis and petiole prominently grooved on the upper side. S. Afr. B.M. 5147. F.S. 23:2446.—Of little value more than a novelty.

C. H. Thompson.

674. Flowers of Bryophyllum pinnatum. (×½)

BUCKEYE: *Æsculus.*

BUCKLEŸA (after S. B. Buckley, American botanist, died in 1884 at Austin, Texas). *Santalàceæ.* Shrubs rarely introduced in botanical collections, without particular ornamental qualities, but interesting as one of the few parasitic shrubs successfully introduced into cultivation.

Leaves opposite, sessile, entire: fls. dicœcious, apetalous; staminate in umbels, with 4 short ovate sepals and 4 short stamens; pistillate solitary, terminal, with 4 short deciduous sepals and below with 4 elongated linear-lanceolate persistent bracts; calyx-tube clavate; style short with 2–4-parted stigma; ovules 3–4: fr. a furrowed drupe.—Three species in China and Japan and 2 in N. Amer.

Only the American species, **B. distichophýlla,** Torr., is in cult. A slender-branched upright shrub, to 12 ft.: lvs. 2-ranked, ovate-lanceolate or ovate, 1–2½ in. long, acuminate, ciliate: fls. small, greenish: fr. an ovoid or oblong-ovoid yellowish green drupe, about 1 in. long, crowned by the 4 persistent bracts. N. C. and Tenn. G.F. 3:237.—Parasitic on the roots of Tsuga. Has proved perfectly hardy in Mass.: there is a plant about 70 years old in the botanic garden at Cambridge. It has also been successfully cult. at the Arnold Arboretum and in a few European botanic gardens. Prop. by seeds; best sown with a potted Tsuga in the greenhouse and planted out with its host when the young plants are strong enough, preferably within the reach of the roots of a large Tsuga, in order that the original host may be removed later when it crowds the young buckleya too much.

Alfred Rehder.

BUCKTHORN: *Rhamnus,* particularly *R. catharticus;* also *Bumelia.*

BUCKWHEAT (*Fagopŷrum esculéntum,* Moench). *Polygonàceæ.* A tender annual grain plant, flour being made of the large 3-cornered fr. It is much grown in the N. U. S., usually being sown about the first of July. It is also a favorite for bee forage. Buckwheat is native to Cent. Siberia and Manchuria, and is now widely cult., although it is a grain of secondary importance. The Tartarian buckwheat (*F. tatáricum,* Gaertn.) is occasionally seen. It has smaller and yellowish fls., and a smaller roughish, wavy-angled fr. This species is often confounded with forms of *F. esculentum,* from which it is really easily distinguished. Buckwheat is a good cleaning crop for weedy and hard lands. For general discussion of buckwheat, consult Cyclo. Amer. Agric., Vol. II. See *Fagopyrum.*

BUDDING: *Graftage.*

BUDDLÈIA (after Adam Buddle, an English botanist). Syn., *Buddlea. Loganiàceæ.* Ornamental shrubs or trees, chiefly grown for their handsome flowers profusely produced in showy panicles or globular heads.

Woody plants or rarely herbs, more or less covered with a stellate, glandular or scaly pubescence: lvs. opposite, short-petioled, entire or serrate: fls. in racemes, panicles or clusters; corolla tubular or campanulate, 4-lobed; stamens included, 4: fr. a 2-celled caps. with numerous minute seeds.—About 70 species in tropical and temperate regions of Amer., Asia and S. Afr., of which only a small number of hardier species is cult.

The buddleias are deciduous or sometimes half-evergreen trees or shrubs with usually quadrangular branches, narrow rather large leaves and small lilac, violet, white or yellow flowers in showy panicles or clusters. None of the species is hardy North, but some, as *B. japonica, B. Davidii, B. Lindleyana* and *B. intermedia* will live through the winter, if protected with dry leaves around the base; even if the stems are killed nearly to the ground, they will freely push forth young shoots in spring, which usually flower the same year. The handsomest in flower are *B. Colvillei, B. Davidii, B. asiatica, B. globosa* and *B. officinalis.*

They grow best in a rich, well-drained soil, in a sunny position; they are rather coarse plants and need much space. Propagation is readily effected by seeds sown in spring in gentle bottom heat, by greenwood cuttings under glass, or by hardwood cuttings taken off in fall and kept during the winter in a frost-proof room.

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A. *Corolla small, with long, narrow tube, ½–¾in. long.*

B. *Fls. in panicles.*

C. *Color violet or lilac.*

D. *Lvs. glabrous or only slightly grayish tomentose beneath: stamens inserted below the middle of the tube.*

1. japónica, Hemsl. (*B. curviflòra,* André, not Hook. & Arn.). Three to 6 ft., with spreading quadrangular, winged branches: lvs. ovate-lanceolate, acuminate, remotely denticulate or coarsely dentate, slightly tomentose or nearly glabrous beneath, 3–6 in. long: fls. in dense, terminal, pendulous racemes, 4–8 in. long; corolla slightly curved, lilac with grayish tomentum outside. Japan. I.H. 17:25. R.H. 1870, p. 337; 1878, p. 330.

2. intermèdia, Carr. (*B. japónica* × *B. Lindleyàna*). Hybrid of garden origin, similar in habit to *B. japonica.* Lvs. ovate-oblong, dark green above, 4–5 in. long: fls. violet, in slender, arching or pendulous racemes, 10–20 in. long. R.H. 1873:151. Var. **insígnis,** Rehd. (*B. insígnis,* Carr.), has the upright habit of *B. Lindleyana.* Branches distinctly winged: lvs. oblong-lanceolate, often in 3's: racemes erect, rather dense, 4–6 in. long, usually panicled at the end of the branches, with rosy violet fls. R.H. 1878:330.

3. Lindleyàna, Fort. (*B. salicifòlia,* Hort., not Jacq.). Three to 6 ft.: lvs. ovate or oblong-lanceolate, acuminate, remotely denticulate, pale green beneath, and slightly pubescent or glabrous, 2–4 in. long: racemes dense, erect, 3–5 in. long; corolla purplish violet, slightly curved, pubescent outside. China. B.R. 32:4. F.S. 2:112. P.M. 14:5. R.H. 1846:201. Var. **sinuàto-dentàta,** Hemsl. Lvs. sinuately-dentate. China.

675
Buddleia Davidii. (×⅙)

DD. *Lvs. densely white or yellowish tomentose beneath: stamens inserted slightly above the middle.*

E. *Tomentum close.*

4. Davídii, Franch. (*B. variábilis,* Hemsl.). Fig. 675. Three to 8 ft.: lvs. nearly sessile, ovate-lanceolate or lanceolate, acuminate, coarsely serrate, whitish-tomentose beneath, 4–10 in. long: fls. in dense, terminal, erect or nodding panicles, 4–6 in. long or in some varieties longer; corolla lilac, with orange-yellow mouth, glabrous outside. Aug., Sept. China. B.M. 7609. R.H. 1898:132; 1902, p. 383. G.C. III, 24:139. Gn. 55:428; 64, p. 153. M.D.G. 1908:136.—A very handsome species with showy and fragrant fls. appearing in great profusion in late summer; several varieties differing from the type which has rather lax panicles of lilac-purple fls. with an orange eye not very marked, by larger and denser panicles and brighter color. Var. **Veitchiàna,** Rehd. (*B. variábilis* var. *Veitchiàna,* Hort.). More robust, erect at first, later gracefully arching, with denser and larger clusters of bright mauve-colored fls. with a bright orange eye; begins to bloom early in Aug. J.H.S. 27:182. J.H. III. 45:381. G.M. 51:45. G.W. 16, p. 538. Var. **magnífica,** Rehd. & Wilson (*B. variábilis* var. *magnífica,* Wilson). Similar to the preceding: has larger deep rose-purple fls. with deep orange eye and the margin of the petals reflexed, panicles very dense; begins to bloom about the middle of Aug. Gn. 68, p. 161; 69:288. R.B. 33:281. F.S.R. 3, p. 339. G.M. 52:668. Var. **supérba,** Rehd. & Wilson (*B. variábilis* var. *supérba,* DeCorte). Color of fls. like the preceding variety but petals not reflexed at the margin and panicles larger. R.B. 35:12. Var. **Wilsonii,** Rehd. & Wilson (*B. variábilis* var. *Wilsonii,* Hort.). Tall and arching, with longer and narrower lvs.: panicles drooping, rather loose, sometimes attaining 30 in. length; corolla smaller, bright rose-lilac with bright orange eye; corolla-lobes half upright and reflexed at the margin: in full bloom through Sept., the latest of all. There are also other named varieties.

5. officinàlis, Maxim. Shrub, to 8 ft.: branchlets nearly terete, grayish tomentose: lvs. oblong to linear-lanceolate, 2–6 in. long, entire or serrulate, grayish pubescent above, whitish or fulvous tomentose beneath: fls. lilac with orange eye, fragrant, in terminal panicles usually 4–6 in. long, consisting of short-peduncled dense clusters; corolla over ⅓in. long with a slender tube pubescent outside and within and twice as long as the oval obtuse lobes. W. China. B.M. 8401. G.C. III. 49:200.—Tender; flowers during the winter in the greenhouse like *B. asiatica.* Page 3566.

EE. *Tomentum fluffy, white or yellowish: stamens inserted just below the mouth.*

6. nívea, Duthie. Shrub, to 8 ft.: branchlets, the under side of the lvs. and infl. densely covered with a pure white woolly tomentum: lvs. ovate-lanceolate, 4–9 in. long, acuminate, coarsely serrate, glabrous above: fls. lilac or purple, small, in long terminal panicles; corolla with the tube tomentose outside, glabrous within except at the mouth. Aug., Sept. W. China. G.C. III. 38:275.—Very distinct on account of its white fluffy tomentum, but fls. less showy than in most other species, nearly embedded in the fluffy tomentum of the infl. Tender. Var. **yunnanénsis,** Rehd. & Wilson (*B. macrostàchya* var. *yunnanénsis,* Dop). Tomentum less fluffy, yellowish: lvs. pubescent above: fls. larger; panicles usually solitary. W. China.

cc. *Color white: stamens inserted just above the middle of the corolla.*

7. **asiática,** Lour. (*B. neémda,* Roxbg.). Shrub or small tree: branchlets terete with white or buff-colored tomentum when young: lvs. lanceolate, 4–8 in. long, acuminate, entire or serrulate, glabrous above, white or buff tomentose beneath: fls. white, very fragrant, in slender drooping panicles, 3–6 in. long and usually several at the end of the branchlets; corolla with the tube villous outside and spreading suborbicular erose lobes or in a less desirable form with ovate, erect and entire lobes. Jan., Feb. China, India, Java. B.M. 6323. G.C. III. 39:106. Gn. 69, p. 89; 76, p. 80. J.H. III. 52:180. G.W. 10, p. 502.—A very desirable greenhouse shrub on account of its slender spikes of deliciously fragrant white fls. in winter. If prop. early in spring, transplanted several times or planted out during the summer, the plants will be of sufficient size in autumn to flower the following winter.

ccc. *Color yellow.*

8. **madagascariénsis,** Lam. (*B. heterophýlla,* Lindl.). Straggling shrub, 6–20 ft., with densely tomentose branchlets: lvs. ovate-oblong, rounded or slightly cordate at the base, acuminate, entire, dark green and lustrous above, whitish or yellowish tomentose beneath: fls. tomentose outside, in large terminal panicles, appearing during the winter. Madagascar. B.R. 15:1259. B.M. 2824.—Hardy only in subtropical regions. Sometimes cult. in Calif. and used as a half-climbing plant to cover unsightly objects.

bb. *Fls. in globular heads.*

9. **globòsa,** Lam. (*B. capitàta,* Jacq.). Three to 10 ft. with the branches and lvs. beneath yellowish tomentose: lvs. ovate or ovate-lanceolate, acuminate, crenate, rugose above, 3–7 in. long: fls. orange-yellow, in dense, long-peduncled, axillary heads at the ends of the branches, fragrant. Chile. B.M. 174. Gn. 33, p. 369. G. 28:505. G.M. 53:979. F.S.R. 3:335 (habit).—A graceful and very distinct shrub, standing some degrees of frost.

aa. *Corolla with broad cylindrical tube, limb over 1 in. broad.*

10. **Cólvillei,** Hook. & Thoms. Shrub, occasionally tree, to 30 ft.: lvs. elliptic-lanceolate or lanceolate, serrate, pubescent, and pale or grayish green beneath, 5–7 in. long: panicles broad, pendulous, 12–18 in. long; corolla purple or crimson, with white mouth. B.M. 7449. R.H. 1893:520. I.H. 41:10. F.S. 14:1487. J.H. III. 31:85.—The most beautiful of all buddleias, and a very desirable shrub for warmer temperate regions; only older plants flower freely.

B. albiflòra, Hemsl. (B. Hemsleyana, Koehne). Allied to B. variabilis. Shrub or small tree, to 30 ft.: lvs. lanceolate, 5–9 in. long, glabrous above, white or yellowish tomentose beneath: fls. small, lilac, in elongated spikes, sometimes to 20 in. long. W. China. G. 27:501.—Less handsome than B. variabilis: fls. not white, as the name implies, given under the impression that the fls. were white. —*B. americàna,* Linn. Shrub, 8–12 ft.: lvs. ovate to oblong-lanceolate, cuneate at the base, glabrous above, yellowish tomentose beneath, 4–10 in.: fls. in terminal densely tomentose panicles consisting of sessile subglobose clusters. Mex. to Peru.—*B. auriculàta,* Bentb. Straggling shrub: petioles auriculate; lvs. oblong-lanceolate, entire or denticulate, grayish white tomentose below, 1½–3 in. long: fls. cream-colored, fragrant, tomentose outside, in terminal compact panicles; stamens above the middle. S. Afr. G.C. II. 16:633; III. 6:529. I.T. 1:20. Tender.—*B. brasiliénsis,* Jacq. f. Upright shrub: sts. quadrangular: lvs. ovate to oblong-deltoid, crenate-serrate, white-tomentose below, 4–8 in. long, decurrent into the winged auriculate petiole: fls. orange-yellow, pubescent outside, in axillary clusters, forming terminal narrow panicles; stamens just below the mouth. Mex. to Brazil. B.M. 2713. Tender.—*B. colúmbiæ,* André. Upright shrub, similar to B. Lindleyana. Lvs. narrow-lanceolate, entire, 4–8 in. long, glabrous: fls. white in terminal slender panicles; corolla with spreading lobes slightly shorter than the corolla-tube. Spring. Of unknown origin. R.H. 1901, p. 37. Tender.—*B. crispa,* Benth.=B. paniculata.—*B. Hemsleyàna,* Koehne=B. albiflora.—*B. paniculàta,* Wall. (B. crispa, Benth.). 6–15 ft.: fls. lilac, in rather dense panicles: branches and lvs. tomentose. B.M. 4793. F.S. 9:958.—*B. pulchélla,* N. E. Br. Shrub, 2 ft.: branchlets terete, tomentose: lvs. hastate, irregularly lobed, or rhomboid to lanceolate, 1–2 in. long, pubescent: fls. white with orange eye, fragrant, in terminal panicles, 2–2½ in. long; corolla with slender tube, pubescent outside. S. Afr.(?).—*B. salicifòlia,* Jacq.=Chilianthus arboreus.—*B. saligna,* Willd.=Chilianthus arboreus.—*B. stenostàchya,* Rehd. & Wilson. Allied to B. nivea. Less fluffy: lvs. oblong-lanceolate: panicles usually 3, long and slender; fls. larger, anthers inserted above the middle of the tube. W. China.

ALFRED REHDER.

BUDS. A bud is an incipient shoot or short growth-axis concealed by the closely investing leaves, or leaf-parts, that it bears. The foliage-shoots and flower-shoots of all seed plants arise from buds. The leaves converge over the true stem-apex or growing-point. The essential thing is that this growing-point continues the terminal growth and gives rise laterally, behind the point, to new leaves, in the axils of which buds may be formed ultimately. In the plumule of the seed the first bud activity is manifest, and thenceforth a bud marks every growing stem-apex.

676. Apple buds—fruit-bud on the left, leaf-bud on the right.

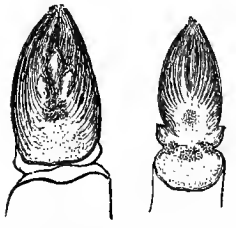
Normally the leaves arise back of the stem-apex, first as small protuberances, which soon flatten laterally. They grow faster than the stem-apex, and by more rapid growth on the under surface they bend over, forming for the time a part of the bud or bud-cluster of leaves which effectively protects the delicate tip. In many herbaceous plants the shoot elongates throughout the growing period, so that each leaf or whorl of leaves in turn has a more or less equal work as a part of the bud. As the apex elongates and each leaf develops, greater growth on the inner (upper) surface effects its complete exfoliation. Using favorable material, one may completely dissect the bud, laying bare the growing-point, which may be readily examined with a hand-lens. Either of the little pondweeds commonly cultivated, Elodea or Hippuris, may be used for this purpose.

The buds which are commonly most conspicuous and at the same time most highly specialized are the "resting" buds of temperate shrubs and trees. Such buds are often scaly buds, and they are characteristic of all climates in which there is an interruption to growth, either through cold or dryness. In this case the stem-apex and younger leaves are normally inclosed by persistent more or less indurated leaf-parts modified as bud-scales. Resinous secretions may accompany the scales and the younger leaves may be covered with hairs. The size, form and minute characters of such buds vary widely, but obviously they are, in general, wondrously efficient in the resistance exhibited towards rigorous climatic conditions. The important point is that the bud-structures quite effectually prevent drying out of the young shoot which is there tucked away.

Particularly interesting is the fact that the resting-bud of many trees includes in miniature the entire vegetative or flowering shoot of the next season. In such case the rapid elongation of the axis and unfolding of leaves in the spring is soon followed by the formation of a new resting-bud wherein the shoot of another year is gradually differentiated. Every gradation occurs between this type and the typical active bud of annuals.

677. Pear twigs—fruit-buds on the left, leaf-buds on the right.

Interest in buds centers in their spring activity, properly in the awakening and growth resulting when the conditions have remained favorable sufficiently long. Leaves and axes enlarge and elongate rapidly, bursting asunder the dead scales and often carrying forward the expanding younger ones. The growth of the younger scales exhibits the true nature of these structures, some of which are found to be leaf petioles, some petioles with minute blades; and various other modifications occur. Many resting-buds are awakened from their comparative inactivity by a few days of favorable weather. These are "early" flowers, and of this type are the lilac and the golden bell. Other buds require a longer period, such as the oak and the hickory. It is not strange, therefore, that some plants lend themselves readily to early forcing by etherization, the hot water treatment, and the like, while others are with great difficulty forced.



678. Sections of pear buds—fruit-bud on the left, leaf-bud on the right.

In the preceding, more specific mention has been made of buds which develop leafy shoots, that is of leaf-buds. It is clear, however, that the resting-bud, as well as an herbaceous bud, may develop a single flower, as in the peach; a cluster of flowers, as in the red maple; or a shoot with leaves and flowers, as in the apple and Norway maple. The occurrence of leaf- and flower-buds with respect to the age of the twig and the relation of pruning to bud disposition are questions of special horticultural interest, but cannot receive consideration in this brief account. Illustrations of flower-buds and leaf-buds are shown in Figs. 676–679.

Buds are normally produced terminally and in the axes of leaves, the latter arrangement therefore corresponding to leaves; but under exceptional circumstances they may arise from the growing tissue of any member. Buds from the roots of the sweet potato and dahlia are important in propagation; likewise are those produced by the leaves of certain species of Begonia. As a matter of fact, buds originating from internodes, roots and leaves—so-called regenerative-buds—are not uncommon; but the development in such situations occurs as a rule only when normal buds are not present.

Buds with the leaves and leaf-parts surrounding them are sometimes organs of food-accumulation. The typical bulb is little more than a fleshy bud, and there are all gradations between the typical bulb and the typical tuber—the latter with many buds. Small bulb-like buds occur in *Lilium bulbiferum* and a few other plants, and they are always important in propagation. It requires no stretch of the imagination to classify the edible shoots of brussels sprouts among unusual buds, and from this it is no great leap to the monstrous "bud" of the cabbage.

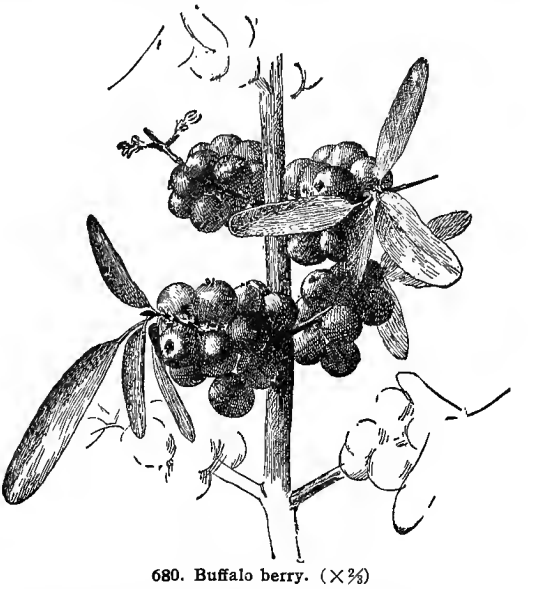
Literature: Bailey, Lessons with Plants, The Macmillan Company; Strasburger (*et al.*), A Text-Book of Botany, The Macmillan Company; Percival, Agricultural Botany, Duckworth & Co.

B. M. Duggar.

679. Buds of the peach. The middle bud is a leaf-bud and the large side buds are fruit-buds.

BUETTNÈRIA (D. S. Aug. Buettner, 1724–1768, German botanist). *Byttneria. Sterculiàceæ.* About 50 herbs, shrubs or trees of diverse habit, native to eastern and western tropics, scarcely known in cult. Some are prickly climbers or scramblers. Fls. small, usually dark purple or greenish, in umbels or cymes; petals 5, long-clawed, hooded and oddly appendaged at the top: fr. a 5-celled, globose spiny woody caps. One species is catalogued in S. Calif.: **B. urticifòlia,** Schum., from S. Brazil, Argentina: Climbing shrub; branches grooved, spiny, nearly glabrous: lvs. long-petioled, cordate-ovate, acuminate, coarsely serrate, appressed-hairy on both sides: fls. ⅓–½ in. across, 3–5 in a stalked umbel.

BUFFALO BERRY (*Shephérdia argéntea,* Nutt. *Lepargỳræa argéntea,* Greene). *Elæagnàceæ.* Fig. 680. A shrub 6 to 18 feet in height, native from Manitoba and Saskatchewan south to Colorado, Nevada and New Mexico, now grown in the upper Mississippi Valley and northward for its abundant acid fruits.



680. Buffalo berry. (×⅔)

The buffalo berry was brought into use early, mention being made in Hovey's Magazine of Horticulture for 1841, page 251, of its being frequently cultivated. It is a handsome ornamental shrub, with silvery foliage and red berries. Occasional plants are found with yellow fruit. The plant is dicœcious; therefore, care should be taken, if fruit is desired, to plant both staminate and pistillate plants. Western nurserymen are beginning to offer these two kinds of plants separately in the ratio of one staminate to four pistillate plants, but the best proportion is not yet known. Many persons who plant the buffalo berry are disappointed by securing only one sex. The staminate or male plants may be known in their winter condition by the dense clusters of rounded flower-buds; the pistillate or female plants by the smaller, flattened, fewer, more slender flower-buds.

The fruit varies greatly in size, quality and season, and is gathered in large quantities for culinary use. It makes a delicious jelly. Some berries are of sprightly flavor, good for eating out of hand. They can also be dried for winter use. The fruit is generally considered better when touched by frost, less sugar being required. The name is said to have come from the custom of eating the berries as a sauce with buffalo meat in the early days. The buffalo berry makes a fine thorny hedge, that is both useful and ornamental.

It is found that sprouts received as dug up in the native thickets from various parts of the Northwest do not always transplant satisfactorily; a year in a nursery row gives them better roots and secures an

even stand when set in their permanent place. Seedlings are better rooted. Seedlings are easily raised from seed washed free from the pulp in the fall and stratified for winter, keeping in sand in a box buried just beneath the surface in a well-drained spot in the garden. There should be holes in the box for free drainage and the planting should be done very early in the spring. In Bulletin No. 88, June, 1904, of the South Dakota Experiment Station, Plate 19 shows a field of 7,500 buffalo berry plants of the first generation under cultivation. These plants were raised from seed gathered along the Missouri River of South Dakota, where buffalo berries are especially abundant. However, under cultivation the plant does not respond, as regards early bearing, as quickly as its near relative the Siberian sandthorn (*Hippophaë rhamnoides*). It was found that the buffalo berries can be worked on the Russian form of oleaster (*Elæagnus angustifolia*). The fault of the buffalo berry is its small-sized fruit and the difficulty of gathering it, owing to its numerous thorns, but it has been and is an abundant source of pleasant fruit to thousands of settlers in the newer regions of the West. The fruit varies greatly in size and degree of acidity, affording opportunity for selection work in its native home along the Missouri River and tributaries. N. E. HANSEN.

BUGBANE: *Cimicifuga.*

BULB, BULBS. A bulb is a thickened, fleshy, and commonly subterranean bud, usually emitting roots from its under side. The office of the bulb is to carry the plant over an unpropitious season, as over winter or a dry period.

True bulbs are either tunicated, formed in rings or layers, like those of hyacinths and onions (Fig. 681), or scaly, like those of some liliums (Fig. 682); but as popularly understood and in commercial parlance, the term bulbs applies to a large class of flowering and ornamental bulbous-like plants in their dormant condition, during which period they are collected, dug, stored, shipped, sold and planted, like so many potatoes. This class includes, in addition to the true bulbs, many that are botanically known as corms, which are solid, as crocus and gladiolus (Fig. 683); tubers which are succulent and have the buds or eyes near the surface, as the dahlia and potato (Fig. 684); rhizomes, fleshy, creeping underground stems like certain iris, ginger, and many wild plants (Fig. 685); pips, the flowering crowns of lily-of-the-valley; and certain other dormant fasciculated fleshy roots like those of peonies, ranunculus, and the like. A variety of bulbs is shown in Fig. 686. The true or feeding roots grow generally from the base of the bulb, the stems, flowers and foliage from the crown of the bulb, or the eyes. There is an exception to this in certain lilies, which throw out roots above the bulb also (Fig. 687). The bulb is a storehouse for the plant, wherein is formed, after flowering, new stems, leaves and flowers. In fact, the bulb contains a new plant, which is protected and sustained within the bulb by the reserve food and energy collected therein during one season for the plant's successor. After the flowering period, the plant above the bulb and the roots beneath it ripen off and die away. The bulb is then in a dormant condition. It is during this state of rest, lasting approximately from three to six months, that bulbs are taken out of the ground and transported easily and safely from continent to continent, if required; after which the incipient roots, stems, foliage and flowers may develop with as much luxuriance and perfection as if the bulb had remained in its original environment.

681. Onion bulbs.

Bulbous flowering plants (bulbs) are very popular with flower-loving people. There is a particular charm and interest in growing them. As a rule, they produce flowers of remarkable beauty, unsurpassed by any other class of plants, and many of them are deliciously fragrant. They comprise an endless variety in habit, form, size and color, are adaptable for many purposes, and many of them flower equally well under either garden or house culture. Soon after their beauty fades they die away, or may be removed; and in the interval, their places may be occupied by other seasonable flowering plants. Not the least among the merits of bulbs is their ease of culture, and the great certainty and perfection with which their flowers are produced, under suitable conditions.

Among bulbous plants are many that are sufficiently hardy to withstand the severity of our northern winters. The kinds that are suitable are nearly all dormant in the fall, which is the proper time for planting them, and they will flower the coming season. In March or earlier, spring is ushered in with the blooming of snowdrops, chionodoxas, anemones, scillas, crocus, winter aconites, bulbocodiums and so on, followed in April with brilliant hyacinths, tulips, narcissus and hosts of others. In April appear the unapproachable late tulips, poet's daffodils, dicentras and the like, followed in succession until frost, notably with peonies, irises, hemerocallis, lilies, montbretias, tritomas and others.

Gardeners usually think of bulbs as divided into two classes,—hardy and tender, or those that stand freezing and those that do not. There is a class from South Africa known as Cape bulbs, which usually bloom in the fall. There are now so many improved hybrids and breeds that are crowding out the types, that the term "Cape bulb" has lost its significance in this country. In the present article, bulbs are treated under the following general heads: Hardy spring bulbs for design bedding; hardy bulbs in the herbaceous garden, mixed flower-border or lawn; subsequent treatment of outdoor bulbs; summer- and autumn-flowering tender bulbs for spring planting; bulbs for flowering in the house and greenhouse; the forcing of bulbs; other indoor methods; subsequent treatment of forced bulbs; keeping dormant bulbs, tubers, and the like; propagation of bulbous plants; hints on buying and selecting bulbs; catalogue of bulbs.

Hardy spring-flowering bulbs for design bedding.

The only bulbs adapted to geometrical beds are Dutch hyacinths and tulips. It is not best to use both in the same bed for really fine effects. For display bedding in parks, public squares, and like places, only solid bright contrasting colors as a rule are used, since brilliancy of coloring is advisable when the taste of large crowds must be considered. This limits the selection in hyacinths to dark crimson, rose-red, pink, purple, blue, lavender, white and yellow (the latter is seldom satisfactory), and in tulips to dark blood-red, scarlet, rose, blush-pink, yellow, white, and a bluish claret, which last is seldom used. On private grounds many beautiful effects can be obtained by the use of the softer colors, particularly in beds that are situated in partial shade. In ordering the bulbs for this style of bedding, it is important to select kinds that bloom at the same time and are of uniform height; and in the case of hyacinths to choose varieties with a strong stem,

for many sorts are liable to fall over from the weight of the spike and are quickly soiled when they lie on the ground. If the item of expense is to be taken into account, it is possible to use second-size bulbs of hyacinths, often listed as bedding sizes, with satisfactory results, although only fine bulbs give fine bloom.

In planting bulbs in "design beds," it pays for the extra trouble first to remove the soil to a depth of 6 inches, spade up the lower soil, using well-rotted manure and plenty of bone dust worked in. Then level off, smooth, and cover with an inch of sand. This prevents the manure from touching the bulbs, and allows the water to drain away from immediate contact with them, thus removing causes which may lead to their decay. Bulbs set in this manner on the sand may be placed in their exact position, after which the top soil is carefully replaced. It is a difficult matter to set bulbs just 4 inches deep and 4 to 6 inches apart with an ordinary trowel. The planter is almost sure occasionally to chop off a piece of a neighboring bulb or displace it. Bulbs planted in the manner advised, being all of an even depth, will flower uniformly; often, when planted with a trowel, some bulbs will be an inch too high and some an inch too low, which in early spring makes considerable difference in the time of blooming. Besides, when bulbs are planted with a trowel or dibble, there is danger of "hanging" a bulb occasionally, where it may perish on account of not touching bottom.

682. Scaly bulb of Lilium pardalinum.

Hardy bulbs in the herbaceous garden, mixed flower-border, or lawn.

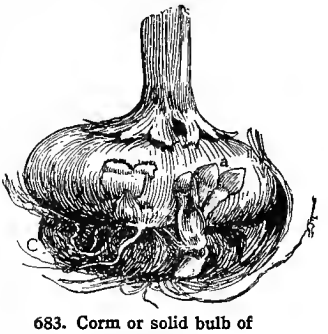
The mixed border is a favorite place for most hardy bulbs. They should be planted in little colonies here and there among the hardy plants and shrubs; and it is here that bulbs seem to thrive and give the most pleasure. As spring approaches, the somber winter browns and dull greens of the deciduous and evergreen plants are suddenly transformed into an unrivaled setting, studded with brilliantly colored and fragrant flowers, the contrasts being exceedingly effective and cheery; and besides, from the border one does not hesitate to cut a few flowers for the house for fear of spoiling the effect, as would be the case in formal bedding. Furthermore, bulbs seem to do better and last longer in a border because the flowers are cut freely in bud or when just approaching their prime, which is the best possible time for the benefit of the bulb, for the efforts of any bulb to form seeds weakens the bulb. A hyacinth bulb that matures seed is virtually destroyed. Then again, in an herbaceous border the bulbs are not disturbed through the necessity for replacing them with other flowering plants, as such a mixed border when properly planted should do much itself to hide the withering leaves. The foliage then remains uninjured until ripe, thus fulfilling its duty of recharging the bulb with new energy for the next season's display. Of course, after three or four years, the bulbs should be divided if they have grown and spread, and judgment must be used to determine when the lifting should be done with the least injury to the other permanent subjects in the border. It is best, perhaps, to associate with the bulbs plants that are not seriously injured by being moved.

Bold clumps of the taller bulbous plants are very effective on the lawn, where beds of one kind should be isolated, and be given a position not too prominent nor too near. The object desired is a mass of one color, which at a little distance is more striking on account of the contrast with the surrounding green grass and trees. Among the best hardy bulbous plants for this purpose are: hemerocallis, such lilies as candidum, Henryi, tigrinum, speciosum and auratum; also dicentra, crown imperials, montbretias, tritomas, peonies, and Kaempferi and germanica irises.

Bulbs planted right in the sod on the lawn make a very pleasing picture when in bloom in the early spring. Make patches here and there of golden, white and purple crocus, the little chionodoxas, snowdrops, *Scilla amœna*, winter aconite, snowflakes, bulbocodium and triteleia. These grow, increase, bloom and ripen the foliage mostly before it is necessary to use the lawn-mower, so that the surface of the lawn in summer is not marred. The bulbs may be dibbled in when the ground is moist and soft during the fall rains, but it is better to cut and turn back the sod here and there, plant the bulbs under it, then press the sod back again.

For parks, groves and wild outlying grounds beyond the closely clipped lawn, a very happy style of "naturalizing" bulbous and other plants is coming much into vogue. Such bulbs should be used as can be planted in quantity, twenty-five to a hundred or more of a kind in a patch, and only those should be used which are hardy, and will flower and thrive and increase under neglect. Fortunately, there are many bulbous plants that succeed even better in such rough places than in the prim garden. Among them are hardy anemones, camassia, convallaria, dicentras, erythroniums, funkias, certain iris, liliums, poet's narcissus, Von Sion and many other narcissi, trilliums, and numerous others.

In regard to the preparation of beds for hardy bulbs, planting and treatment, one can only generalize. Detailed directions suited to the different species, and also varieties where treatment varies, will be found under their respective headings in this Cyclopedia. As a rule, well-rotted manure (mind that it is well-rotted, not fresh and heating) should be liberally applied and dug into the ground deeply. It must be where the long, feeding roots can get at it, and yet not touch the bulbs, nor be too near their base. This is easily accomplished by removing a few inches of the top soil first, as described under "Design Bedding" above. If it is impracticable to do this, then it is not advisable to use manure at all, for the bulbs are liable to come in contact with it and become diseased. Bone meal alone is then the safest fertilizer to use, and it should be applied lavishly. Most bulbs like rich food if properly applied. Although the embryo flowers were formed within the bulb the season before, yet their size, luxuriance and brilliancy this season depend largely upon the nutrition the roots receive. Liberal applications of manure water, when the bulbs are in bud, often produce excellent results.



683. Corm or solid bulb of gladiolus.

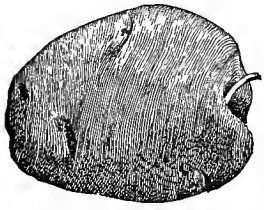
The proper depth to plant bulbs varies according to the kinds. It is a common fault to plant them too near the surface. Some kinds, notably the Californian Humboldtii and Washingtonianum lilies, do best when 10 to 12 inches deep; hyacinths, tulips, narcissi, and similar large bulbs from 4 to 6 inches deep; smaller bulbs somewhat shallower. A good rule to follow is to make the depth three times the average diameter of the bulbs. Hardy bulbs root during the fall and early winter, and if planted too near the surface the freezing, thawing and heaving of the upper crust of soil in mild winters often causes the bulbs to break from their roots, and, in consequence, only inferior flowers are produced. When good cold

weather has set in and a light crust has been frozen on the soil, then cover the bed with leaves, straw, marsh hay or reeds to a depth of about 4 to 6 inches. This protects not only from severe freezing, but from equally injurious unseasonable thaws. Do not put the covering on too early, for it might warm the soil so that the bulbs would begin to grow and afterward be injured from freezing. Gradually remove the covering in the spring.

The general run of bulbous plants thrive in a loamy soil, inclining to sand. This soil attracts moisture, allows free drainage, and admits air. If the soil is cold and stiff, a liberal admixture of leaf-mold and sand, with the addition of manure applied as previously described, will be beneficial. The texture of the soil should be such that stagnant water will not remain around the bulbs, as it tends to rot them, particularly when dormant. An excess of humus is, therefore, to be guarded against for most bulbs.

While most bulbous plants thrive under the soil conditions advised above, yet there are many exceptions. Happy should be the man on whose grounds is found a variety of soils and exposures, shade and sun. A small wooded valley or ravine, with a brook flowing through it into an open, moist meadow, affords conditions suitable for growing to perfection the greatest variety of bulbous and other plants, many of which cannot be enjoyed in the average garden. The hyacinth is a notable exception in regard to soil conditions. In Holland this bulb is grown in pure sand, and soon becomes diseased in heavier soil. This should indicate that in this country plenty of sand should be added to the natural soil, and that the bulbs should not be left in the ground during the summer.

The sooner bulbs can be put in the ground after they are ripe, the better for the bulbs; for, no matter how long they will keep, they do not improve when out of the ground, but tend to dry out and lose vitality. This is particularly true of the narcissi, which give very noticeably larger flowers when the bulbs are planted early. All of the sorts having a strain of poeticus blood begin the new root-growth almost as soon as they have ripened, and are far better off if they can be in the ground early. There are, however, many reasons why bulbs cannot be planted as soon as ripe; and when they are to be kept for certain purposes, they should be stored as advised below. Hardy spring-flowering bulbs should be planted in the open ground in the fall, not earlier than six weeks before regular frosty and freezing nights are expected. Plant as much later as necessary, providing the bulbs are keeping sound, but it is not advisable to plant them earlier. Cool weather is necessary to deter top growth, which is very liable to start after four to six weeks of root development; and young, succulent top growth is apt to be injured by the succeeding freezing. In Maine, Ontario, Wisconsin, and other northern parts (about 45 degrees north latitude), such hardy bulbs as hyacinths, tulips and narcissi, may be planted in September. In New Jersey, Pennsylvania, Ohio, and so on (about 40°), plant about the middle of October. In the latitude of Richmond, Louisville, and St. Louis, the middle of November is early enough. In the latitude of Raleigh, Nashville, and south, do not plant until middle of December; and for the latter section let the selection of bulbs run to late-flowering varieties, such as Bizarre, Darwin, and late double tulips, late hyacinths, late narcissi, and the like, for they are not so likely to be caught by the occasional freezing weather in January and February. In this southern latitude, however, very early-flowering bulbs, such as Roman hyacinths, Duc Van Tholl tulips, Early Polyanthus narcissi, and so on, if planted in September, are usually through blooming before freezing weather begins. South of the freezing belt, hardy spring-flowering bulbs are not very successful, as a rule, there being no sufficiently cool weather to deter top-growth and force root-action first, without which the flowers and foliage will not develop beyond such sustenance as the bulb can supply; and this sustenance is usually exhausted by the time the flower-spikes are half grown. But there are many half-hardy and tender bulbs that are more easily grown and flowered in the South than in the North.



684. Potato.—Example of a tuber.

Subsequent treatment of outdoor bulbs.

The treatment of bulbs after flowering is important when the bulbs are to be used again, for it must never be forgotten that the flowers and resources for the next season are garnered within the bulb after blooming, through the agency of the roots and foliage. Imperfectly developed and matured foliage this year means poor flowers or none at all next year; so it is best to leave the bulbs alone until the leaves have died down. The further treatment depends upon the kind of bulbs under consideration. Generally speaking, one class may be left in the ground for a number of years, while another thrives better if lifted annually and given a short period of rest out of the ground. Among this latter class must, of course, be included tender bulbs which will not survive the winter if left in the beds or borders and which should be taken up in the fall when matured. Of the hardy bulbs, hyacinths and tulips succeed best if lifted annually. Late tulips in borders may be left undisturbed for two or three years with fairly good results, but the single early kinds ought to be taken up each year.

Lifting of any bulbs should never be done before the foliage assumes a decidedly limp and brown appearance. From that time on until the root-growth begins, they may be taken up, cleaned, and stored away, or divided and replanted at once. The former method is advisable for hyacinths and tulips; the latter for most of the bulbs on the list appended hereto. When bulbs are grown commercially, this yearly lifting is essential in order to make provision for propagation by division or by offsets, as the young bulbs mature more rapidly and perfectly when separated from the parent bulb. When summer bedding-plants are to be substituted, it is sometimes necessary to remove bulbs before ripe. In such cases, the bulbs should be carefully taken up with a spade. Disturb the roots as little as possible, and do not cut or crush the leaves. Heel-in the plants in a shallow trench in some half-shady out-of-the-way place until ripe, taking pains to avoid setting them too close in the trench to secure some air-space about the tops. If the soil adheres to the roots when taken from the beds, the bulbs will be less affected by being disturbed before maturing. As soon as ripe, they should be dug up, cleaned, and stored away. A point to be kept in mind is that it is safer to lift tulips too early than too late; these bulbs should be taken up just before the stems are quite dry. By doing so the protective skin about the bulb is more likely to be retained during the time the bulbs are out of the ground. Darwin tulips have especially thin skins which frequently loosen and come off entirely if the bulbs are left too long, and then the bulbs tend to become soft and flabby during the resting period. Narcissi should be taken up with whatever foliage has not quite withered away. Indeed, it is always wisest never to cut a leaf from choice kinds, but to make plantings of cheap kinds if leaves are wanted for cutting.

Summer- and autumn-flowering tender bulbs for spring planting.

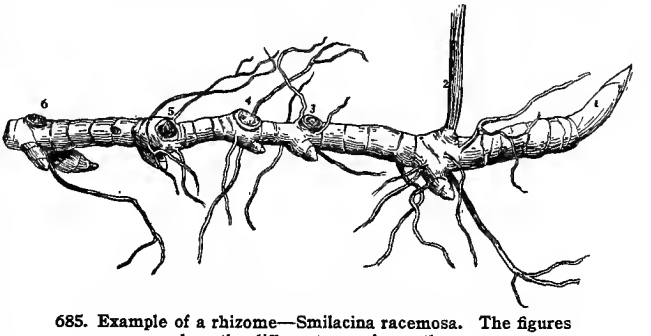
This class (tender) includes some of our showiest garden flowers, which are almost indispensable. They are of the easiest possible culture. Planted in the spring,

after danger from frost is over, in a sunny position in good rich soil, they will flower with great certainty the same season. After flowering and ripening of the foliage, they should be taken up and stored for the winter as advised under "Keeping dormant bulbs" (p. 593) until wanted next spring. Among the more important species of this class of bulbs are the undermentioned (those marked F must be kept in a semi-dormant condition in a coldframe or greenhouse): Agapanthus (F), alstremeria (F), amorphophallus, anomatheca (F), antholyza (F), tuberous begonia, bessera, colocasia (caladium), cooperia, crinum, cypella, gladiolus, galtonia (*Hyacinthus candicans*), boussingaultia (madeira vine), montbretia, nemastylis, border oxalis, ornithogalum (F), pancratium, richardia (calla), schizostylis (F), sprekelia, tigridia, tuberose, watsonia, zephyranthes.

Bulbs for flowering in the house and greenhouse.

There is no class of plants that gives more satisfaction for this purpose, with so little skill, than the various bulbs. Perhaps the most important class of all bulbs for winter-flowering and forcing are certain hardy and half-hardy kinds. They are the most easily managed of all, and need occupy no space in the window or greenhouse, excepting when in bud and bloom. Under suitable treatment, they flower with great certainty, and their flowering period may be hastened (forced) or retarded at pleasure, so as to "bring them in" for certain occasions, or to give a continuous succession of bloom. There is a great variety of kinds of bulbs to select from for this purpose (see list of species at end of this article), yet the great demand, at this writing, has centered on the following leaders, especially for forcing purposes: *Allium neapolitanum, A. Hermettii grandiflorum, Anemone fulgens*, convallaria (lily-of-the-valley), *Freesia refracta alba*, gladiolus "The Bride," early single-flowering Dutch hyacinths and Romans, Campernelle jonquil, *Lilium candidum, L. Harrisii* and *L. longiflorum*. Several narcissi are in demand, notably among the large trumpet varieties: Emperor, Empress, Golden Spur, Horsfieldii, and Spurius major; among the medium and small trumpets: Sir Watkin, Barrii conspicuus and Poeticus ornatus; of the doubles are Von Sion and Orange Phœnix; of the Polyanthus narcissi: Paper White grandiflora (Totus albus), and double Roman (Constantinople). Of other species of bulbs, *Ornithogalum arabicum*, spirea Gladstone, and single and double tulips of the early varieties are in demand. In the classes of bulbs there is often a great diversity in the fitness of the varieties for forcing. Certain sorts will be found best adapted to early forcing, others to midseason or late work, and in selecting bulbs for forcing these characteristics must be taken into consideration. Besides this general division into early and late forcing kinds, the skilled grower recognizes that each variety has its own peculiar period when it is at its best, if forced. Many tulips and narcissi are very fine if forced early and only moderately good if forced late; the converse is equally true, for often an early variety will do only indifferently well when it is used for late work. This characteristic is well studied by one of the largest forcers for the English market, who devotes whole separate houses to particular varieties of tulips, and puts in charge of each one man who knows the whims of the variety he tends. This should not, however, deter anyone from attempting to force bulbs, as success is sure to be gained if standard forcing kinds are used, and the few important rules are followed. The principles of culture for hardy bulbs for winter-flowering are the same, whether only a few are grown in pots for the window-garden, or whether they are to be forced by the thousand by the florist. The first essential is to secure the strongest bulbs. Remember that the flowers were formed within the bulbs the previous season. If one buys bulbs of narcissi containing only one flower, or hyacinths with only ten bells on a spike, the best culture possible cannot make them produce more; but good culture will develop such flowers larger and better.

The next most important essential—one might say the secret of success in flowering bulbs in house or greenhouse—is perfect root-development before the tops begin to grow. To aid the uninitiated in this important matter, we will illustrate: When hardy bulbs are planted in the open ground in the northern states in the fall, the weather above them is cool or cold, the ground beneath



685. Example of a rhizome—Smilacina racemosa. The figures show the different years' growths.

them is warmer, and the conditions are congenial for root-action but deterrent to top-growth. This results in the perfect development of such flowers as the bulbs contain. On the other hand, when hyacinths, tulips, narcissi, and most other hardy spring-flowering bulbs are planted in fall in our extreme southern states, they may prove disappointing, because the weather is warm, causing the flowers and foliage to begin to grow before the roots; and as soon as such sustenance as the bulb could supply has been exhausted, the plant stops growing and dwindles. When one grows bulbs under artificial conditions, one must make them produce roots first. Failure to do this is responsible for nine-tenths of the disappointments.

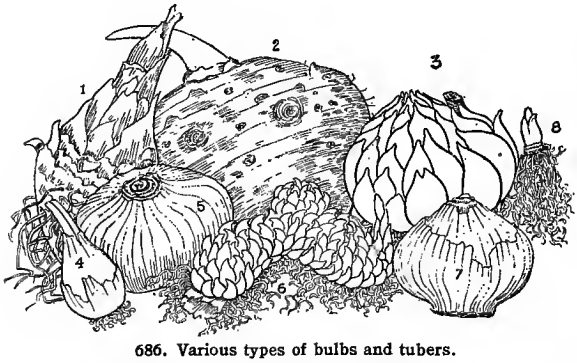
When hardy bulbs are to be grown in pots for winter blooming in the house or conservatory, the bulbs should be potted as soon as they are procurable, between August and November. Some writers recommend that bulbs be planted in successional lots to give later and continuous flowers, but such advice is at fault, as the bulbs tend to dry out and lose vitality when kept dry too long. It is no trouble to retard the flowering of hardy bulbs in winter, as hereafter described, without keeping them out of the ground.

The soil should be rich loam. Fresh manure cannot be used. Of thoroughly rotted manure, some may be pulverized and worked into the soil, but it is safer to use pure bone meal, one part to fifty of soil. If the soil is stiff and heavy, mix with it sand and leaf-mold or peat. The size of pots depends upon the kinds of bulbs. A 5-inch pot is best for a first-sized hyacinth, or large-bulbing narcissus, particularly the polyanthus type. Tulips, small narcissi, and bulbs of a similar size, while they can go individually into a 4-inch pot, are better when put three or more of one variety together in a larger pot, as the soil retains a more even temperature and moisture; and for this reason some prefer earthen bulb-pans, which come in various sizes, from 8 to 18 inches in diameter. In potting, place a little broken pottery or lumps of charcoal in the bottom for drainage, then fill the pot with soil and shake it down, but do not pack it. Neither must the bulb be pressed or screwed into the soil, else the soil will be packed under it so that when the roots start they often raise the bulb out of the pot. Plant the bulb just deep enough that its top will not show. Large and soft bulbs, which are liable to rot, may be set in a cushion of sand, and the bulb not covered with soil until it has taken root and become established (Fig. 688).

When planting mixed bulbs in the same pot, pan or box, care should be used in selecting different varieties that will flower at the same time. An early-flowering Duc Van Tholl and a double Tournesol tulip would flower a month apart under the same treatment. Some varieties of hyacinths, of narcissi, and of most species of bulbs vary greatly in time of blooming, which, of course, would spoil the effect.

The forcing of bulbs.

When florists force bulbs in quantity for cut-flowers, they seldom use pots, but shallow boxes, or flats, of a size to economize bench-room. Usually these boxes are cut down from soap-boxes to a depth of 3 or 4 inches. The bulbs are planted closely in these, from an inch to 2 inches apart, according to the kind. The tops of the bulbs (excepting lilies) are kept about even with the top of the soil. Give a thorough watering to help settle the earth about the bulbs, but give no more water until growth begins, for bulbs in a dormant condition resent an excess of moisture. After the bulbs are potted, or boxed, as described, they should be placed in a cold-frame or cold-pit to root. This is the most important detail in flowering bulbs under artificial conditions.



686. Various types of bulbs and tubers.
1. Tuberose. 2. Colocasia antiquorum (*Caladium esculentum*). 3. Easter Lily. 4. Jonquil. 5. Gladiolus. 6. Lilium pardalinum. 7. Hyacinth. 8. Lily-of-the-Valley.

Cover the pots, boxes or pans with 4 inches of sand, ashes, rotted leaves, tanbark or similar substance, and do not put the sash on until freezing weather, and even then remove the sash on pleasant days. When no coldframe or pits are available, the pots may be covered as advised in a cool cellar, provided close attention is given to be sure that the soil is maintained in a uniformly moist, but not wet condition. It is preferable however, to sink them in the open ground. Very fine flowers were obtained from hardy bulbs when treated as follows: A trench a foot deep is dug in the garden where water will not settle in it, and it is protected from the north and west cold. Three inches of coal-ashes is first placed in the trench, to allow drainage and keep the worms out. The pots are then placed on the ashes, the earth is filled in about the pots, filling the trench rounding over. When the weather gets cold enough to freeze a crust on the soil, an additional covering of about 4 inches of rough stable manure, leaves or straw, is put over. This cover must be heavy enough to keep the pots from freezing, not that this will injure the bulbs, but that it will be almost impossible to remove the pots if the covering of earth freezes solid. Care should be taken that the sides of the trench do not fall in, depositing a layer of earth over the leaves or other cover, which will freeze hard enough to make removal difficult. Often a simple cover of 8 to 10 inches of leaves directly over the pots will be most advantageous if earth has been worked in about the sides of the pots to retain moisture. No further attention is required, as everything is congenial to perfect root-development, while the weather is cool enough to check top-growth. Some early bulbs, such as Roman hyacinths, Paper White narcissi, Duc Van Tholl tulips, and the like, will root sufficiently in five or six weeks to be taken up for first flowers, which should be out by Christmas or earlier, but it is safer to allow all bulbs not less than eight weeks for rooting. A fairly sure indication that the bulbs are ready to be brought into heat is the appearance of about an inch of top growth, and of an abundance of roots through the bottom of the boxes or through the holes in the bottom of the pots. Every two weeks after the first removal of pots, or as needed, further relays of rooted bulbs may be taken out for a continuous display of bloom. When the pots of hardy bulbs have been taken up, place them in a cool greenhouse or cool, light storeroom, with temperature not over 50°. This temperature will allow the flower-stems and foliage to grow, and at the same time prevent the opening of the flowers until the stems have attained their proper height. The pots should be kept shaded for several days until the top-growth has taken on its natural green color, after which the pots may be taken to a sunny, warm window, or wherever they are wanted to flower. Bulbs treated in this manner will produce perfect spikes of flowers.

A practice often followed by florists early in the season is keeping the bulbs in the dark and in heat in order to draw out the flower stems to a proper height. This can often be accomplished by placing an inverted pot over the tops, the light coming through the hole in the bottom being sufficient to draw out the stems. If this is done, the bulbs must be watched to see that the tops are all growing evenly; should some of the bulbs get a start of the others, the pots must be put in the light at once to avoid irregularity in flowering. For early work, this darkening, together with strong bottom heat, will give longer foliage and stem than if the bulbs are subjected to strong light when first brought under glass. But plenty of fresh air must be afforded, and as the buds begin to show color the pots must be removed to a cooler temperature to harden the growth, and enough light given to put color in the foliage and the buds.

A good rule to keep in mind in flowering hardy bulbs is: Temperature, 40° for roots, 50° for foliage and stems, 60° for best flowers, 70° for quick development, 80° to rush bloom with loss of substance and risk of "going blind" (producing no flowers).

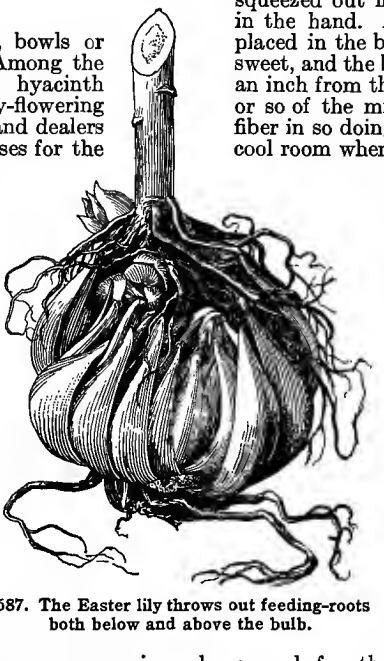
The exceptions to the above advice are liliums and lily-of-the-valley. The bulbs of *Lilium Harrisii*, *L. longiflorum* and the various sorts of *L. speciosum*, in addition to throwing out roots from the base of the bulbs, usually form roots from the new stem just above the bulb, and the plants and flowers derive much strength from these top-roots. So in potting lily bulbs, it is best to put them down so deep that there will be sufficient soil above the bulbs to entice and sustain the stem-roots. This may be done when the bulbs are potted, or 2 or 3 inches of soil may be added after growth is under way and the stem-roots have begun to work into the soil. An advantage in the latter method is that some fertilizer may be mixed with the new soil, and sustenance provided when it is most timely. In other respects treat the bulbs after potting as just advised. Winter-flowering lily-of-the-valley forms no new roots. The thick, fleshy, fibrous old roots should be trimmed at the bottom, leaving them from 2 to 3 inches long. This allows them to absorb the abundant moisture with which they should be supplied while the flowers and foliage are developing. They flower just as well in sand or moss, or anything that retains an even moisture and temperature, as they do in soil, but lily-of-the-valley for flowering in the house or greenhouse requires freezing before it can be successfully brought into flower. Without freezing, many pips will "come blind," or pro-

duce malformed spikes. So it is just as well for amateurs to plant their pips an inch or two apart in pots or bulb-pans, and plunge them in the garden, as recommended for other hardy bulbs. Florists generally freeze their pips in refrigerators, or have them placed, just as they arrive from Germany, 2,500 pips in a case, in cold storage, in a temperature of 28° to 30°.

Half-hardy bulbs for winter-flowering and forcing should be treated the same as hardy bulbs, except that after potting they should be placed for rooting where they will not freeze. Yet they can go fairly close to it and be all the better for it. In northern states, a coldframe or pit or cold greenhouse to root them in is, therefore, almost indispensable. For tender winter- and summer-flowering greenhouse bulbs, the culture varies with almost every species, and as no general instructions would suit all kinds, the reader may refer to their individual cultures given under their respective headings in this Cyclopedia. (See list of species at the end of this article.)

Other indoor methods.

The flowering of bulbs in glasses, bowls or unique pots, is always interesting. Among the most successful and interesting are hyacinth bulbs in glasses of water. Use early-flowering single varieties only. The seedsmen and dealers in bulbs supply special hyacinth glasses for the purpose. They come in various shapes, colors and decorations, and vary in price from 20 cents to $1.50 each. These are simply filled with fresh, pure water. A lump of charcoal thrown in absorbs impurities, but it is not absolutely necessary. The bulb rests in a cup-shaped receptacle on top of the glass. In filling, the water should not quite touch the bottom of the bulb. Put in a cool, dark, airy place until the roots have reached the bottom of the glass, which should be in about six weeks. Do not place them in a close, warm closet. They must have fresh air. As the water evaporates, fill the glasses, and change the water entirely when needed to keep it sweet and clear. After rooting, place the glasses in a light store-room where the temperature averages about 50°, until the stems and foliage have developed; then remove to a warm, sunny window for flowers to open. There are other kinds that do equally well when rooted in water, providing the largest healthy bulbs are chosen. Among them are sprekelia (Jacobæan lily), Trumpet narcissi Horsfieldii and Golden Spur, polyanthus narcissi Grand Monarque and Gloriosa, large bulbs of Roman hyacinths, early single tulips, and Mammoth Yellow crocus. Hyacinths have been flowered on a piece of virgin cork floating in an aquarium, a hole being cut through the cork for the roots to reach the water. The so-called "Chinese sacred lily," a variety of Polyanthus narcissus, grows and flowers luxuriantly in bowls of water, provided they are not placed in a dry, furnace-heated room, which will cause the buds to blast before opening. Sufficient pebbles or shells should surround the bulbs to prevent them from toppling over.



687. The Easter lily throws out feeding-roots both below and above the bulb.

Crocuses, Roman hyacinths, and lilies-of-the-valley are very pretty when nicely flowered in columnar, hedge-hog- or beehive-shaped hollow pots with holes for the reception of the bulbs. A bulb is placed in front of each hole from the inside, with the crown of the bulb looking outward. The pot is then filled with soil through the large opening in the bottom, moss being pressed in last to hold the contents in place, after which the pots are put outside for the bulbs to root, as explained for other hardy bulbs for the house.

The growing of bulbs in moss fiber, a method introduced by Robert Sydenham, of Birmingham, England, is well deserving of attention by the amateur. The great advantage of this method is that the bulbs can be grown in decorative china bowls, without drainage, while the compost is clean to handle and, as the bowls are not porous, they may be set about a room without danger of spotting the most highly polished woodwork. The compost is made up of moss or peat fiber and ground oyster-shell in the proportion of three parts dry moss to two parts of the shell; a little pulverized charcoal added tends to keep the material sweet. The moss must be rubbed between the hands thoroughly to break even small lumps and then mix the shell with it very carefully, after which water should be slowly added in the proportion of four quarts to each half-bushel of the mixture. When properly moistened the compost should feel quite damp but no water will be squeezed out if a small quantity is pressed tightly in the hand. A few pieces of charcoal should be placed in the bottom of the bowl to keep the fiber sweet, and the bowls should be filled to within about an inch from the rim. Cover the bulbs with an inch or so of the mixture, taking care not to pack the fiber in so doing, and place the bowls in a cellar or cool room where they can have plenty of fresh air. For about three weeks the mixture will itself provide sufficient moisture, but after that time they must be examined frequently; nothing is so essential as keeping the fiber uniformly damp to the very bottom of the bowls but there must be no water standing. If dry for but a day there is great risk of the bulbs going blind. The treatment from this point on is identical with that given for bulbs grown in ordinary potting soil.

Subsequent treatment of forced bulbs.

After being forced or flowered in the greenhouse or window, hardy bulbs are of little value, for most bulbs suitable for the purpose have attained their maximum size, and, in consequence, are ready to break up. Florists usually throw these bulbs away. However, if space can be spared for the bulbs to complete their growth after flowering, and watering and temperatures are watched, many of them can be matured to be utilized afterwards. The ripening of the foliage is as necessary to forced bulbs as it is to those grown in the open, and to promote this the potted bulbs should receive enough care and nourishment to counteract the artificial conditions under which they are grown. When it is desired to keep forced bulbs, the compost should be made somewhat richer at potting time. After flowering, the pots may be plunged out-of-doors, if freezing weather is over, until the foliage has ripened. Then the bulbs can be shaken out and planted in the mixed border or about the kitchen-garden, where some of them will recuperate and give flowers for cutting within a year or two, and eventually they will regain their vigor sufficiently to be transferred to the bulb-garden. Yet with most of the bulbs the labor involved is scarcely commensurate with the returns, and the bulbs might just as well be discarded at the beginning.

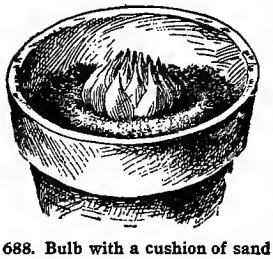
Keeping dormant bulbs, tubers, and the like.

Bulbs and tubers of the various species, as well as their varieties, vary greatly in size. Some, like oxalis, snowdrops, and chionodoxas, often do not exceed half

an inch in diameter, while other bulbs, such as those of *Caladium esculentum*, certain arums and crinums, attain great size, frequently weighing several pounds each. Such solid bulbs as those of tulips, hyacinths and narcissi, will remain out of the ground solid and plump, in a suitable place, for three or four months. The larger the bulb the longer it will keep, as a rule. Large crinum bulbs have been kept for fifteen months. Still, it is always better to plant the bulbs as soon as possible, for, although they keep, they do not improve, and their tendency is always toward drying out and loss of vitality.

Never keep bulbs packed air-tight. They are liable to generate heat or sweat, mold or rot, or to start. When solid bulbs are to be kept dormant for any length of time, they should be stored away from bright light in baskets, shallow boxes or slatted trays, protected from rats or mice, in a room or cellar in which there is a circulation of fresh air and the temperature is as cool as possible. Forty degrees is the desideratum for all excepting tender bulbs. Scale-like bulbs, as liliums, soon dry out and shrivel, if exposed to the air for any length of time; therefore, they are best kept in open boxes packed with some substance that will retain a slight and even moisture, such as sphagnum moss, rotted leafmold, coconut fiber refuse, or moist sand, but they must be kept cold to check any efforts to start. Fleshy roots, like those of peonies, and so on, should be treated like the lily bulbs. When a cold-storage room, with an average temperature of 36° to 40°, is available, it is the safest place to carry over hardy bulbs and roots for spring planting.

Lily-of-the-valley pips are carried in cold storage rooms of about 28° to 30°. The pips and packing freeze solid; and here they are kept for months until wanted for forcing. When they are removed, they must be thawed out gradually and as soon as possible, by plunging in cold water, before they are subjected to any heat; otherwise, they are likely to rot. For this reason, "cold-storage pips" cannot be safely shipped any distance in warm weather, this often being the cause of the country florists' disappointment in results.



688. Bulb with a cushion of sand beneath it to prevent decay.

Tender dormant bulbs, as begonias, gloxinias, amaryllis, pancratiums, tigridias, tuberoses, must be kept in a warm, dry atmosphere, not below 50°. The cause of tuberoses not flowering is often that the bulbs have been kept below 40°, which destroys the flower germ, although the foliage grows just as vigorously. Tender tubers, such as dahlias and cannas, should be stored in dry sand in a warm, dry cellar or under the greenhouse bench.

Propagation of bulbous plants.

Bulbous plants increase usually in either of two natural ways—from division or from seed. Increase by division, with true bulbs and corms, is due, in the first place, to the tendency these plants have after reaching a certain age to break up into a number of smaller parts, each part making a new start for itself and developing with time into a bulb of flowering size. In addition to this breaking up, all bulbs, even those of young growth, form tiny bulbels or offsets, throughout their time of maturing. These bulbels appear in many ways, some forming outside of the protecting skin of the mother bulb, as in the case of the tulip and hyacinth, others developing about the base of a newly-formed corm like the gladiolus. In this connection it is proper to note that the formation of bulbs during the growing season varies in that some kinds form an entirely new bulb, as the tulip and gladiolus, and others merely add new tissues to the old bulb and increase in size, as the narcissus and hyacinth. As a rule, small bulbs obtained by this process of breaking up do not have the vigor of those from offsets; the younger a bulb is, the greater vigor it always has, although the flower may not show its true size.

Whereas bulbs secured by division always come true, —that is, the flowers resemble that of the parent bulb, allowing for the occasional variation due to "sporting"— propagation by seed is likely to give new varieties, differing in character from the original. Certain kinds of bulbs, such as the scilla, chionodoxa, or freesia, can be propagated by seed and come true, unless cross-fertilized. Bulbs grown from seed take longer to mature than do those from offsets, and for commercial purposes the seed method is seldom employed except when the raising of novelties is an object.

Of the other so-called bulbous plants which are under consideration here, the tuberous kinds increase naturally by the development of new eyes which grow into young plants as the old tuber decays, while the rhizomatous sorts form new plants through the elongation and branching of the running underground stems accompanied by the dying back of the older parts. Artificial propagation of these kinds is an easier affair than with true bulbs, as the separation of the new growth is readily effected by division with a knife, or even with the rougher use of a spade. Such tubers as potatoes, begonias and gloxinias can be cut into small parts wherever an eye has started, and these planted out separately grow into new plants. With certain kinds it is a frequent practice to dust over the tubers where the cut has been made with sulfur or soot to prevent decay. Caution must be used in following this method, as too frequent division of this sort results in weakening the vigor of the stock to be grown. Several tubers, such as the dahlia and begonia, can be propagated either by stem or leaf cuttings taken from the young growth.

Artificial propagation of the hyacinth by cutting the old bulb is the method employed in Holland, while many liliums are increased by loosening the outer bulb scales and inserting them in sand after the manner of cuttings. Certain bulbs like the tulip, as grown in Holland, are subjected to heat after lifting, to ripen the bulbs more thoroughly. Bulbs to be used for propagating are given a higher temperature, which arrests the flowering and tends to increase the breaking up of the mother bulbs. For special methods of propagating, the reader should consult the articles on the various bulbs throughout this Cyclopedia.

The cultural treatment for the young bulbs is in general the same as that prescribed for the older, larger ones. The offsets need not, of course, be planted so far apart, the very smallest being simply scattered in drills as peas or beans are sown. At first the soil should be somewhat lighter than later on, and must always be kept free from weeds and well cultivated. The young bulbs should be planted early, and when annual lifting is practised they should be the first to come out of the ground.

From an economic point of view it is doubtful whether the so-called Dutch bulbs can be successfully propagated and grown in America. The extremely low cost of labor, and the rapid increase of stocks in the soil and climate of Holland, together with the fact that the secret of ripening the bulbs to perfection is known thoroughly only by the Dutch, makes it improbable that bulbs can be grown as well, or with a reasonable profit, here in America.

Hints on buying and selecting bulbs.

As already said, bulbs can develop only the flowers which were formed within them before they were ripened. A bulb may be poor because not full-grown or too young, or because grown in impoverished soil or under

uncongenial conditions, or because it may not have been matured when dug; or it may be injured from heating, sweating, rotting or moldiness in storage or transit, caused by improper curing or packing, or it may be dried out from having been out of the ground too long. In the majority of cases in which poor bulbs are planted, however, it is the buyer's fault in procuring cheap bulbs, which in many cases are second grades, lacking age and proper size. The commoner varieties of a species usually propagate the fastest, and it is generally these less salable varieties and inferior seedlings and cullings from the named bulbs that go to make up most "mixed colors" and "mixed varieties." Therefore, for best results, it is advisable to expend a given amount of money for the first-size named varieties, rather than for a larger quantity of cheaper seconds and mixtures, unless, of course, the bulbs are wanted for large permanent plantings, as in promiscuous borders for naturalizing, in which best flowers the first season are of secondary consideration.

The best named hyacinths—"top roots," as they are called in Holland—require from four to six years to attain full size and give best flowers. Such bulbs, according to the variety, should measure from 20 to 24 centimeters (8 to 10 inches) in circumference. These naturally cost more to grow than the younger second or "bedding" grade of bulbs, measuring from 18 to 20 centimeters (6 to 8 inches). There is a third size, ranging from 16 to 18 centimeters (4 to 6 inches), that goes in mixtures, and a fourth size (12 to 14 centimeters) that goes out as "Dutch Romans," "Pan Hyacinths," "Miniatures," and so on. Some growers even scale their sizes a centimeter or two less than mentioned, to enable them to quote lower prices. Crocus, narcissi, tulips and many other bulbs are also sorted into sizes, enabling the growers to catch all classes of buyers.

A first-size crocus bulb should measure 10 centimeters (4 inches) in circumference, and such bulbs produce from six to twelve flowers each. A small, cheap bulb produces only two or three flowers. A narcissus bulb of maximum size will produce from three to five flowers (sometimes more), and an inferior size usually but a single flower. A white Roman hyacinth bulb 14- to 16-centimeter size (5 to 6 inches in circumference) will produce three and often four spikes of firsts and several seconds, while an 11- to 12-centimeter size will average only one first-grade spike and a couple of seconds, or perhaps nothing but seconds. The best lily-of-the-valley pips bear from twelve to sixteen bells on a spike, usually all firsts. Cheaper inferior grades of pips have seldom more than seven to ten bells. If the florist or planter wants the best bulbs, he must pay more money for them, but they are cheapest in the end, for second-grade stock takes up just as much room and requires as much care, fire, and other expenses. It is the grade of flowers called firsts that sell and pay a profit. The supply of seconds is often so abundant that the market price for them does not pay the cost of the bulbs.

Mere size alone should never be taken as the standard in judging bulbs, however, as in this respect there is always a great difference among varieties of the same kind of bulb. A plump, solid bulb, without any suspicion of flabbiness, will give far better blooms than one without these qualities, but if size goes with them the purchaser will be just so much better satisfied. Furthermore, the selection of varieties is of importance since in recent years a great many vastly improved varieties in all classes of bulbs have been introduced. The growers, nevertheless, because of the demand for the older sorts, of which they have large stocks, continue to list many kinds no longer worth growing, unless cheap bulbs are wanted. Attention ought also to be paid to the fact that a number of varieties appear in the lists under different names, a feature of the bulb trade which often leads to great confusion although the reliable dealers usually note synonymous names in such cases. Cheap bulbs may often be secured through the auction sales in fairly good quality, but it is utterly impossible to count upon these being true to name, or even to color. The surest way to obtain first-class bulbs

689. A good pot of narcissi.

is always to purchase from a trustworthy source, and to state clearly, when buying, the exact purposes for which the bulbs are intended and the amount which the buyer desires to spend.

Catalogue of bulbs.

To aid in the selection of bulbs for particular purposes, is appended a list of the leading species that are procurable while dormant (between the months specified) from seedsmen and bulb dealers, and a sign is affixed to each to indicate the purpose for which the species—or certain varieties in it—are adapted. Some kinds are useful for more than one purpose, and such have a corresponding number of signs. For example: If a selection of bulbs is to be made for winter-flowering in the house, make a note of those to which an asterisk (*) is affixed, then turn to their respective headings in this Cyclopedia, where will be found other advice and descriptions; read all cultural instructions carefully, and consult good growers and reliable dealers for the most recent varieties in any species, remembering that new varieties frequently appear.

For winter-flowering bulbs for greenhouse or window, select from species marked *.

For summer- and fall-flowering bulbs for pots for greenhouse and other decoration, select from species marked †.

For spring-flowering hardy bulbs for gardens, lawns, and the like, select from species marked ‡.

For summer- and fall-flowering hardy bulbs for gardens, lawns, and the like, select from species marked ‖.

For summer- and fall-flowering (not hardy) bulbs for spring planting in garden, and the like, select from species marked §.

For climbing bulbous plants, select from species marked ¶.

Those marked H *are hardy;* HH, *half-hardy;* T, *tender.*

GENERA, ETC.	HARDINESS.	DORMANT.
Abobra ¶ §	HH	Oct. to Apr.
Achimenes†	T	Oct. to Apr.
Agapanthus † §	HH	Oct. to Apr.
Albuca †	T	Oct. to Apr.
Allium * ‡	H & HH	Aug. to Dec.
Alstrœmeria † §	HH	Sept. to Nov.
Amaryllis * †	T	Oct. to Apr.
Amorphophallus §	T	Oct. to Apr.
Anemone * ‡	H & HH	Aug. to Nov.
Acomatheca §	HH	Oct. to Apr.
Antholyza §	HH	Oct. to Apr.
Apios ¶ ‖	H	Oct. to Apr.
Arisæma †	HH	Oct. to Apr.
Arum * †	T	Aug. to Apr.

GENERA, ETC.	HARDINESS.	DORMANT.
Babiana *	HH	Aug. to Nov.
Begonia, Tuberous † ♀	T	Oct. to Apr.
Bessera ♀	HH	Oct. to Apr.
Blandfordia *	T	Aug. to Nov.
Bloomeria ‡	H	Aug. to Nov.
Bomarea ¶ †	HH	Aug. to Oct.
Boussingaultia ¶ ♀	T	Oct. to Apr.
Bowiea ¶ †	HH	Oct. to March
Bravoa †	HH	Oct. to Apr.
Brodiæa * ‡	HH	Aug. to Oct.
Bulbocodium ‡	H	Aug. to Oct.
Caladium † ♀	T	Oct. to Apr.
Calochortus * ‡	HH	Aug. to Nov.
Camassia ‖	H	Aug. to Nov.
Canna ♀	T	Oct. to Apr.
Chionodoxa * ‡	H	Aug. to Oct.
Chlidanthus ♀	HH	Oct. to Apr.
Colchicum ‖	H	Aug. to Sept.
Commelina ♀	HH	Oct. to Apr.
Convallaria * ‡	H	Oct. to Apr.
Cooperia ♀	HH	Oct. to Apr.
Corydalis ‖	H	Aug. to Apr.
Crinum † ♀	T	Nov. to Apr.
Crocosmia ♀	HH	Oct. to Apr.
Crocus * ‡	H	Aug. to Oct.
Crown Imperial ‡	H	Aug. to Oct.
Cummingia †	T	Aug. to Oct.
Cyanella †	HH	Aug. to Oct.
Cyclamen persicum *	T	Aug. to Nov.
Cyclobothra ♀	HH	Aug. to Nov.
Cypella ♀	T	Oct. to Dec.
Cyrtanthus †	T	Oct. to Apr.
Dahlia ♀	T	Oct. to Apr.
Dicentra ‡	H	Oct. to March
Dioscorea ¶ ‖	H	Oct. to Apr.
Eranthis ‡	H	Aug. to Oct.
Eremurus ‖	HH	Oct. to Apr.
Erythronium ‡	H	Aug. to Nov.
Eucharis †	T	Sept. to Dec.
Eurycles †	T	Oct. to March
Freesia *	HH	Aug. to Nov.
Fritillaria * †	H & HH	Aug. to Oct.
Galanthus * ‡	H	Aug. to Nov.
Galtonia ♀	HH	Oct. to Apr.
Geissorhiza †	HH	Aug. to Nov.
Gesneria * †	T	Oct. to Apr.
Gladiolus ♀	HH	Sept. to Apr.
Gloriosa ¶ †	T	Oct. to Apr.
Gloxinia †	T	Oct. to Apr.
Griffinia †	T	Oct. to Apr.
Hæmanthus †	T	Aug. to Nov.
Helleborus ‡	H	Oct. to Apr.
Hemerocallis ‖	H	Oct. to Apr.
Homeria ♀	HH	Aug. to Nov.
Hyacinth * ‡	H	Aug. to Nov.
Hymenocallis ♀ †	T	Oct. to Apr.
Imantophyllum †	T	Oct. to Apr.
Iris, Bulbous * ‡	H & HH	Aug. to Nov.
Iris, Rhizomatous, etc. ‡ ‖	H	Oct. to Apr.
Ismene ♀ †	T	Oct. to Apr.
Ixia *	HH	Aug. to Nov.
Ixiolirion ‡	H	Aug. to Nov.
Jonquil * ‡	H	Aug. to Oct.
Lachenalia *	HH	Aug. to Oct.
Leucojum ‡ ‖	H	Aug. to Oct.
Lilium * ‖	H	Sept. to Apr.
Lycoris ♀ †	HH	Oct. to Apr.
Milla ♀	HH	Oct. to Apr.
Montbretia ‖	HH	Oct. to Apr.
Muscaria ‡	H	Aug. to Nov.
Nægelia * †	T	Oct. to Apr.
Narcissus * ‡	H	Aug. to Oct.
Nemastylus ♀	T	Oct. to Apr.
Nerine †	T	Aug. to Nov.
Ornithogalum * ♀	H & HH	Aug. to Nov.
Oxalis, for borders ♀	HH	Sept. to Apr.
Oxalis, Winter-flowering * †	HH	Aug. to Nov.
Peony ‖	H	Oct. to Apr.
Pancratium † ♀	T	Oct. to Apr.
Phædranassa *	T	Oct. to Apr.
Polygonatum ‖	H	Oct. to Apr.
Puschkinia ‡	H	Aug. to Oct.
Ranunculus *	HH	Aug. to Nov.
Richardia * † ♀	T	Sept. to Dec.
Rigidella ♀	T	Oct. to Apr.
Sanguinaria ‡	H	Oct. to Apr.
Schizostylis * ♀	HH	Oct. to Apr.
Scilla ‡ *	H & HH	Aug. to Nov.
Sparaxis *	HH	Aug. to Nov.
Spiræa (Astilbe) *	H	Oct. to Apr.
Sprekelia * † ♀	T	Sept. to Apr.
Sternbergia ‖	H	Aug. to Oct.
Tecophilæa *	HH	Aug. to Oct.
Tigridia ♀	T	Oct. to Apr.
Trillium ‖	H	Oct. to March
Triteleia ‡	HH	Oct. to Apr.
Tritoma ‖	H	Oct. to Apr.
Tritonia *	HH	Aug. to Nov.
Tropæolum, Tuberous * ¶	HH	Aug. to Dec.
Tuberose ♀	T	Nov. to May
Tulip * ‡	H	Aug. to Nov.
Tydæa * †	T	Oct. to Apr.
Urceolina †	T	Oct. to Apr.
Vallota †	T	Oct. to Apr.
Watsonia * ♀	HH	Sept. to Dec.
Zephyranthes * ♀	HH	Aug. to Apr.

PETER HENDERSON & Co.

BULBÌNE (Greek, *bolbos*, a bulb). *Liliàceæ*. More than 20 species of half-hardy African and Australian plants, allied to Anthericum, but practically not cultivated in this country.

Flowers showy, the petals distinct, 1-nerved, spreading and often recurving in age; stamens shorter than the perianth. Some of the species are bulbous, and require the general treatment given Cape bulbs (see *Bulbs*); but none of the bulbous species is known here.

690. Bulbine annua.

ânnua, Willd. Fig. 690. Annual, acaulescent, without any rootstock or bulb: lvs. 12–20, erect but weak: fls. bright yellow, racemose. S. Afr. B.M. 1451 (as Anthericum). D.C. Pl. Grasses, pl. 8.—Can be grown as an annual S. N. TAYLOR.

BULBINÉLLA: *Chrysobactron*.

BULBOCÒDIUM (Greek, *woolly bulb*). *Liliàceæ*. Crocus-like bulbous plants of mts. of Eu. and Russian Asia, spring-flowering or autumn-flowering.

Leaves appearing after (or before) the fls., usually 3, narrow, sheathed at base: fls. close to the ground, 2–3 from each bulb, the perianth funnelform, segms. distinct to the base but conniving in a tube; stamens 6; style 3-fid. at the top.—One variable species, treated in general as crocuses are cult. Allied to Merendera, to which some of the former species are referred.

vérnum, Linn. Fig. 691. Blooms in gardens in earliest spring before the lvs. appear, the fls. resting nearly on the ground: fls. rosy purple, white-spotted on the interior, 1–3 from each bulb: lvs. broad and channelled. B.M. 153 (cf. Fig. 691). F.S. 11:1149. Gn. 75, p. 409.—Bulbs should be taken up and divided every 2 or 3 years. Plant in the fall. Usually blooms in advance of the crocus. *B. vérsicolor*, Spreng. (*B. ruthénicum*, Bunge), is a small handsome form. L. H. B.

BULBOPHÝLLUM (Greek, *bulb-leaf*). *Orchidàceæ*. Epiphytic plants, creeping upon rocks or trees; cult. in the warmhouse.

Pseudobulbs 1–2-lvd. in the axils of the sheaths, and with the infl. arising from the base of the pseudobulb: fls. small and numerous in a raceme, or larger and few

or solitary; dorsal sepal erect or spreading, free, equaling or shorter than the lateral, which are obliquely broadened at the base and adnate to the foot of the column; petals shorter than or nearly equaling the sepals; lip articulated to the foot of the column, incumbent upon the column; pollinia 4.—A genus of about 125 species, mostly natives of Trop. Asia and Afr.—Bulbophyllum needs a moist atmosphere and should not become dry. Grown on pieces of wood or tree-fern stems.

691. Bulbocodium vernum.

A. *Fls. large, solitary.*

B. *Petals and lip minute; sepals tessellated with pale brown and yellow.*

grandiflòrum, Blume. Pseudobulbs 2–3 in. long, 1-lvd.: lf. up to 10 in. long and 2 in. broad, emarginate at the apex: peduncle usually not exceeding the lf. with 2–4 bracts and a solitary large fl. about 8 in. long; sepals tessellated with pale brown and yellow spots, the dorsal sepal arcuate and incurved, the sides reflexed, the lateral sepals deflexed; petals minute, triangular; lip minute, 3-lobed. New Guinea. B.M. 7787. G.C. III. 17:429.

BB. *Petals and lip large, the former as long as the sepals.*

C. *Lip cordate-triangular; petals reflexed.*

Dèarei, Reichb. (*B. Godseffiànum,* Hort.). Pseudobulbs 1-lvd. up to 1½ in. long: lf. up to 6 in. long, acute: peduncle as long as or exceeding the lf., bearing a solitary large fl.; sepals and petals tawny yellow, the dorsal sepal ovate-lanceolate, red-spotted, the lateral sepals lanceolate, falcate, purple-marked on both sides; petals linear-lanceolate, with the veins deeper, and some purple spots; lip triangular-cordate. Origin uncertain. G.C. II. 20:108 (as Sarcopodium).

CC. *Lip cordate-ovate; petals merely spreading.*

Lóbbii, Lindl. Fig. 692. Pseudobulbs 1-lvd., up to 1½ in. long: lf. about 6 in. long, narrowed into a petiole: peduncle shorter than the lf., bearing a solitary large fl. 3–4 in. across; sepals and petals buff-yellow, the dorsal sepal with lines of purple spots on the back, ovate-lanceolate, the lateral sepals falcate, marked with rose in the center; petals lanceolate; lip yellow, purple-spotted, cordate-ovate, acute. Java. B.M. 4532. G.C. III. 38:184 (var. *colosseum*).

AA. *Fls. less than ½in. long, in a raceme.*

Careyànum, Spreng. Pseudobulbs ovoid or oblong, 1-lvd.: lf. up to 10 in. long and 2 in. broad: scape with many bracts, bearing a dense raceme, 2–4 in. long, of numerous fls. which are orange-yellow or greenish, spotted with reddish brown or purple; sepals oblong-ovate, acute; petals broadly ovate, minutely awned; lip nearly entire. Himalayas.

B. auricòmum, Lindl. Burma. B.M. 7938.—*B. barbìgerum,* Lindl. Lip long, narrow, with a tuft of long purple hairs at the apex. Trop. Afr. Gt. 46, p. 491. B.R. 1942. B.M. 5288. R.B. 30:253.—*B. Binnendìjkii,* J. J. Smith. Java. B.M. 8187. G.C. III. 47:84.—*B. birménse,* Schlecht. Fls. orange-yellow, very small. Burma. O. 1910:107, desc.—*B. Bittneriànum,* Schlecht. Fls. golden yellow: bracts leafy, greenish white, rose-dotted. Siam. O. 1910:108, desc.—*B. calabáricum,* Rolfe. Fls. small, light yellowish green, with a dull reddish purple lip. W. Trop. Afr.—*B. campanulàtum,* Rolfe. Sumatra. B.M. 8281.—*B. capituliflòrum,* Rolfe. Fls. very small; sepals and petals whitish green; lip deep purple. W. Trop. Afr.—*B. chrysocéphalum,* Schlecht. Dwarf plant: fls. yellow. S. E. Asia.—*B. comòsum,* C. and M. Burma. B.M. 7283.—*B. crenulàtum,* Rolfe. Madagascar. B.M. 8000.—*B. cylindràceum,* Lindl. Himalayas. G.C. III. 49:3.—*B. Dayànum,* Reichb. Burma. F.S. 21:2236. G.C. III. 45:194.—*B. dichròmum,* Rolfe. Annam. B.M. 8160.—*B. Dixonii,* Rolfe. Fls. small, greenish yellow with numerous dark brown spots; petals with bristle-like tails at the apex. Siam.—*B. Ericssònii,* Kränzl. Fls. umbellate, the sepals and petals green, spotted with purple-brown, the lip triangular, broadly cordate at base, acute, marked with red-brown. Malay Archipelago. B.M. 8088. G.C. III. 21:61; 32:383. O.R. 15:233.—*B. exaltàtum,* Lindl.. Sepals light green, dotted with brown; lip blackish purple, much fringed. Brazil, British Guiana.—*B. fascinàtor,* Rolfe. Annam. B.M. 8199.—*B. fuscopurpùreum,* Wight. Fls. dull reddish brown, about 1 in. across. S. India.—*B. galbìnum,* Riddell. Malay Penin. B.M. 8216. G.C. III. 42:42.—*B. Gentilii,* Rolfe. Scape 1-2 ft. long, bearing a densely fld. spike; fls. scarcely ½in. long; sepals and petals straw-colored and purple. Trop. Afr. G.C. III. 36:266, desc.—*B. glutinòsum,* Cogn. Fls. arranged in 2 rows in short spikes; sepals greenish, spotted inside with red; petals minute, white; lip red. Brazil. O. 1910:108, desc.—*B. inùnctum,* J. J. Smith. Fls. larger than in B. Lobbii; sepals densely dotted with purple; petals long and drooping. Borneo.—*B. Kérrii,* Rolfe. Lvs. oblong, deciduous: fls. dull yellow, pubescent. Siam.—*B. kindtiànum,* Wildem. Similar to B. barbigerum, but the hairs on the lip are not club-shaped. Congo Free State.—*B. lemniscatoides,* Rolfe. Java(?). G.C. III. 45:68.—*B. lemniscàtum.* Pax. Burma. F.S. 23:2476. Gn. 35, p. 610.—*B. lépidum,* J. J. Smith =Cirrhopetalum.—*B. lilacìnum,* Ridley. Fls. in dense racemes or spikes, lilac spotted with purple. Siam.—*B. longisèpalum,* Rolfe. New Guinea. G.C. III. 42:211.—*B. macránthum,* Lindl. Burma and Malay Archipelago. B.M. 7208.—*B. mandibulàre,* Reichb. f. Borneo.—*B. Medùsæ,* Reichb. f. Malay.—*B. micropétalum* Rodrig. A small plant with spikes of tiny transparent green fls. with prominent blackish purple stripes. Brazil.—*B. miniàtum,* Rolfe. Resembles B. barbigerum but has a broader labellum with white feather-like processes Congo Free State.—*B. mirum,* J. J. Smith. Remarkable for its curious fls.; lateral sepals united; petals consisting of a small round disk with motor filaments. Malaya.—*B. morphologòrum,* Hort. Fls. curious in having a small triangular plate between the dorsal and lateral sepals, Siam.—*B. nigréscens,* Rolfe. Sepals yellow dotted with blackish purple; petals and lip blackish purple. Siam.—*B. nudiscàpum,* Rolfe. Allied to B. barbigerum. Congo.—*B. orthoglóssum,* Kränzl. Malaya. G.C. III. 43: 406.—B. *Pahùdii,* Reichb. f. Malaya. F.S. 22:2268.—*B. papillòsum,* Finet. Raceme twice as long as lvs.; rachis and bracts green; lip dark purple. French Congo.—*B. Péchei,* Bull. Burma. B.M. 7286.—*B. polyblépharon,* Schlecht. Fls. solitary, dark purple. New Guinea.—*B. propínquum,* Hort. Fls. green with dense purple reticulation. Siam.—*B. quadrifàrium,* Rolfe. Fls. inconspicuous. Madagascar.—*B. radiàtum,* Lindl. Fls. yellowish white, with narrow lanceolate petals and sepals: lf. linear. India.—*B. trémulum,* Wight. E. Indies. G.C. III. 49:291. O.R. 9:361.—*B. tridentàtum,* Rolfe. Allied to B. mandibulare. British New Guinea.—*B. trifàrium,* Rolfe. Fls. arranged like the bracts in 3 rows, dull, lurid purple, with numerous minute darker spots on the sepals. Madagascar.—*B. virèscens,* Thouars. Fls. umbellate; sepals and petals 4–5 in. long, pale green, the veins and nerves brown; lip rather fleshy, about ¾in. long, cordate-ovate, pale green, purple at the base. Java. B.M. 8327. G.C. III. 40:260.—*B. Weddélii,* Reichb. f. Brazil. B.M. 7958. G.C. III. 36:382.

692. Bulbophyllum Lobbii. (×⅓)

GEORGE V. NASH.

BULLACE. A name used in England for half-wild, half-domesticated plums very similar in character to the Damsons. In America there exist no plums for which another name can not be preferred. The bullace, or bullaces (for there are several varieties sometimes

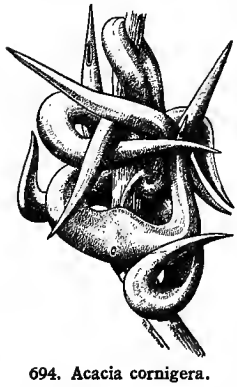
spoken of as bullaces) are usually referred to the botanical name of *Prunus insititia* (e.g., Hedrick, Plums of New York, p. 40); but they are also classified with the Damsons, thus taking the botanical name of *Prunus domestica* var. *damascena* (See Bot. Gaz. 27:481.)

F. A. WAUGH.

693. Acacia cornigera.

BULL-HORN. A name applied to several species of tropical American acacias remarkable for their large stipular inflated spines which closely resemble the horns of an ox or buffalo. These are utilized by certain stinging ants of the genus Pseudomyrma as nesting-places for rearing their young. The thorns, which are connate at the base, are hollowed out by the insects, which perforate one of the spines near the tip, usually on the under side, so that no water can enter. All the species of true bull-horns have a four-lobed involucel on the peduncle of the flower-spike near the base. The bipinnate leaves have nectar-glands on the rachis and petiole, as in many other acacias, and they are still further provided with peculiar processes on the tips of the leaflets, minute wax-like bodies rich in oil and protoplasm, which Thomas Belt, in his "Naturalist in Nicaragua" (1874), discovered to be used as food by the ants inhabiting the spines, and which in his honor were named Beltian bodies. These apical bodies had long been known, and Linnæus called attention to the nectaries on the leaf-rachis, but Belt was the first to suggest that in return for quarters and subsistence the little ants serve their host as a body-guard of soldiers, and Darwin in his work on the "Effects of Cross- and Self-Fertilization in the Vegetable Kingdom," called attention to Belt's interesting observations and deductions.

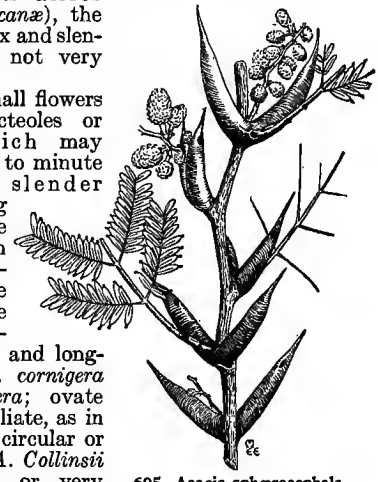
Francisco Hernandez, the *protomedico* of Philip II of Spain, sent in 1570 to study the resources of Mexico, figured the peculiar spines and the leaves of one species growing in the Huasteca region of Mexico, in the Tierra-caliente, not far from the Gulf coast. This author speaks of the intense pain caused by the stings of the ants and describes their larvæ engendered in the hollow spines. Jacquin, in describing a bull-horn acacia growing near Cartagena (Colombia) in 1763, tells how the little insects rush from the thorns when the tree is struck however lightly, falling upon the unwary intruder and inflicting upon him myriads of burning stings. Long before this (1696) Plukenet had figured the bodies on the apices of the leaflets, and Linnæus himself expressed his wonder as to the function of the extra-floral nectar glands.



694. Acacia cornigera.

In all bull-horn acacias, there are two kinds of leaves with accompanying spines: vegetative leaves in which the stipular spines usually become greatly inflated; and bract-like smaller leaves subtending the flower-heads or flower-spikes on the axillary raceme-like flowering branchlets, with stipular spines usually small and subulate. The extra-floral glands on the leaf-rachis and petiole are either crater-like and more or less elongated, or round and bead-like, often several in a series at the base of the petiole and sometimes one between each pair of pinnæ.

The flower-spikes or flower-heads are solitary, geminate, or fascicled in clusters of several in the axils of the small bipinnate leaves on the axillary, raceme-like flowering branchlets. In one species, *Acacia Cookii*, there is apparently no specialized flowering branchlet, but the globose heads are borne in dense clusters in the axils of the large slender-pronged equitant spines. In all true bull-horns the four-toothed involucel is at or near the base of the peduncle. In *A. cochliacantha* the involucel is at the apex of the peduncle, very much as in *A. Farnesiana*. In *A. cornigera*, *A. spadicigera*, and *A. Collinsii*, the spikes are dense, cylindrical and more or less like the spadix of an aroid. In *A. sphærocephala* they are sphæroid-ovate or ovate-oblong, with the flowers closely crowded on a fusiform receptacle. In *A. Cookii*, the heads are perfectly globose with the receptacle also globose. In *A. Hindsii*, which Bentham put in a section (*Americanæ laxifloræ*) apart from *A. spadicigera* and its allies (*Pycnanthæ americanæ*), the flower-spikes are lax and slender with flowers not very closely crowded.



695. Acacia sphærocephala.

Between the small flowers are stipitate bracteoles or umbracula which may readily be likened to minute umbrellas with slender handles protecting the flowers before anthesis from moisture and fungus spores. The laminæ of these may be ovate-acuminate or hastate and long-pointed, as in *A. cornigera* and *A. spadicigera*; ovate with the margin ciliate, as in *A. sphærocephala;* circular or nearly so, as in *A. Collinsii* and *A. Hindsii*, or very broadly ovate, as in *A. Cookii*. The flowers themselves consist of a tubular calyx, four- or five-toothed or almost entire, a corolla of four or five lobes, in *A. cornigera* and its allies only slightly longer than the calyx but in *A. Hindsii* about twice as long. They are polygamous; that is, some of the flowers are entirely staminate, others are both staminate and pistillate. The stamens are numerous, with a single pistil in the hermaphrodite flowers rising from the center of the mass; ovary several-ovuled; style filiform, stigma minute, terminal.

In one division, to which *A. cornigera* and its allies belong, the pods are indehiscent, inflated, thin, chartaceous, terminating in a sharp beak (Fig. 693). In another division, to which *A. Hindsii* and *A. Collinsii* belong, the pods are dehiscent (Fig. 696). In *A. Cookii* they are very long and slender and two-valved. In all cases the hard smooth compressed seeds are surrounded by sweetish yellow or orange-colored pulp, somewhat like that found in the pods of the algarroba, or St. John's bread, which causes the fallen pods to be eagerly sought by pigs and other animals. This peculiarity at once distinguishes the bull-horn acacias from *A. arabica*, the type of the genus, which has dehiscent pods devoid of pulp.

Following are the leading species of bull-horn acacias:

A. *Involucels at the base of the peduncle (Basibracteatæ, Benth.); pedicelled bracteoles of the fl.-heads peltate.* TRUE BULL-HORNS.

B. *Pods indehiscent thin and fragile, terminating in a sharp, spine-like beak.*

C. *Laminæ of pedicelled bracteoles (umbracula) ovate-acuminate or hastate: fl.-spikes dense, cylindrical; inflated spines broadly spreading or incurved, closely resembling the horns of an ox.*

D. *Peduncles of fl.-heads puberulent: laminæ of the bracteoles long-acuminate, more or less scabrous above; inflated spines usually brown or chestnut-colored at length.*

A. cornígera, Linn. (Arbor cornigera, Hernandez). HUITZ-MAMAXALLI. BULL-HORN. CUERNITOS. ARBOL DE LAS HORMIGAS. ANT-TREE. Figs. 693, 694. A shrub or small tree with 1–3 erect sts. and a few lateral branches bearing numerous large inflated spines remarkable for their close resemblance to the horns of an ox or buffalo. The pods are eaten by pigs and other animals. E. Trop. Mex.

DD. *Peduncles of fl.-heads glabrous: laminæ of bracteoles short-acuminate not scabrous above: inflated spines usually ivory-white or yellowish.*

A. nicoyénsis, Schenck. NICOYA BULL-HORN. ESPINO BLANCO. WHITE-SPINED BULL-HORN. A shrub or small tree resembling the former. Occurs in Costa Rica, Guatemala and the adjacent regions of Mex. and Salvador.

CC. *Laminæ of pedicelled bracteoles ovate, ciliate, not acuminate: fl.-spikes sphæroid-ovate or ovate-oblong: inflated spines not broadly spreading, often V-shaped or U-shaped.*

A. sphærocéphala, Cham. & Schl. BULL-HORN. CUERNITOS DE VERACRUZ. CORNIZUELO. ARBOL DE LAS HORMIOAS. ARBOL HORMIGUERO. Fig. 695. A shrub or small tree resembling A. cornigera, from the state of Vera Cruz.

BB. *Pods dehiscent, coriaceous or woody.*

C. *Fls. in globose heads on long thick peduncles clustered in the axils of long fork-like spines: pods very long.*

A. Coùkii, Safford. BULL-HORN ACACIA OF ALTA VERAPAZ. A small tree or shrub with slender fork-like inflated thorns inhabited by stinging ants. Guatemala.

CC. *Fls. in elongated spikes, borne on special flowering branchlets, in clusters of several, subtended by small bipinnate lvs. with subulate stipular spines or by a pair of spines only: laminæ of pedicelled bractsoles circular or nearly so.*

D. *Spikes dense rigid oblong-cylindrical: pods thick and woody, straight or slightly curved, obtuse or shortly acuminate: larger spines swollen at base, usually U-shaped and equitant.*

A. Cóllinsii, Safford. A shrub or small tree with inflated U-shaped, olive-greenish or brownish stipular spines curving upward, and sometimes twisted around the branch. S. Mex.

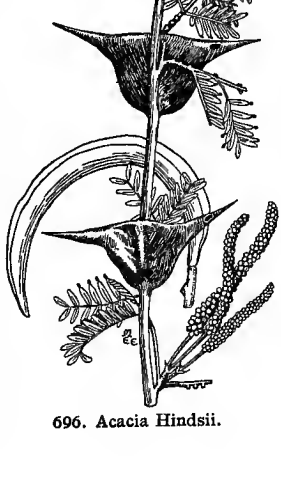
DD. *Spike lax, flexible, linear: pods coriaceous, slender, falcate usually long-acuminate: larger spines very broad and flat, terminating in widely diverging, very sharp points, like an inverted bicorn chapeau.*

A. Hindsii, Benth. BROAD-THORN ACACIA. BULL-THORN OF MAZANILLO. BUFFALO HORN. Fig. 696. A small glabrous tree remarkable for its broad flat stipular thorns, which resemble in form an inverted military chapeau. W. coast of Mex.

AA. *Involucel at the apex or above the middle of the slender peduncle: laminæ of the bracteoles ovate-ciliate (not peltate): larger spines stout and straight widely diverging. Fls. in globose heads, solitary or geminate, on flowering branchlets, subtended by a small bipinnate lf. with subulate stipular spines or by a pair of small spines only: larger inflated spines at length split longitudinally.*

A. cochliacántha, H. & B. (Mimosa campeachiana, Miller). SPLIT-THORN ACACIA. SPOON-THORN ACACIA. This species is not a true bull-horn since its peduncles have not a basal involucel and its stipular spines instead of being hollow and subject to the perforations of ants become split longitudinally.

W. E. SAFFORD.



696. Acacia Hindsii.

BUMÈLIA (ancient Greek name for an ash-tree). *Sapotàceæ*. BUCKTHORN; also IRONWOOD. Woody plants sometimes cultivated in botanical collections, but without particular ornamental qualities.

Small trees or shrubs with milky or gummy sap and very hard wood: branches usually spiny: lvs. alternate, entire, short-petioled: fls. mostly perfect in axillary clusters, long-pedicelled; calyx 5-lobed, persistent; corolla campanulate, 5-lobed; lobes longer than tube with a small appendage on each side; stamens 5, adnate to the corolla, and 5 petal-like staminodes; ovary 5-celled, pubescent: fr. a 1-seeded drupe.—About 20 species from the southern states to Brazil.

These are evergreen or deciduous small trees or shrubs, usually spiny, with generally obovate to oblong leaves and inconspicuous white flowers on axillary clusters followed by black subglobose to oblong-ovoid drupes. None of the species is of much horticultural value, but as most of them grow naturally on dry, rocky or sandy soil, they may be used sometimes with advantage for planting in similar situations. The hardiest are *B. lanuginosa* and *B. lycioides*, which have proved hardy in sheltered positions at the Arnold Arboretum. Propagation is by seeds.

lanuginòsa, Pers. CHITTIM WOOD. Tree, sometimes 50 ft.: lvs. oblong-obovate or cuneate-obovate, rounded and often apiculate at the apex, dark green and lustrous above, tomentose beneath, sometimes nearly glabrous at length, 1–2½ in. long: clusters many-fld.; pedicels slender, hairy: fr. oblong-ovoid or obovoid, ½in. long. S.S. 5:247. H.T. 376. Southern states north to S. Ill., west to Texas.—This is the species most often met with in collections.

B. angustifòlia, Nutt. Shrub or small tree, to 25 ft.: lvs. persistent, obovate to oblanceolate, glabrous, 1–1½ in. long.; fr. oblong. Fla. S.S. 5:249.—*B. lycioìdes*, Gaertn. Shrub or small tree, to 25 ft.: lvs. deciduous, elliptic to oblong or oblanceolate, acute, glabrous, 1½–4 in. long: fr. ovoid. Va. to Ill., Fla. and Texas. S.S. 5:248.—*B. ténax*, Willd. Shrub or small tree, to 30 ft.: lvs. obovate to oblanceolate, pubescent beneath, 1–3 in. long: fr. oblong. N. C. to Fla. S.S. 5:246.

ALFRED REHDER.

BÙPHANE (Greek, *cattle-destroyer*, alluding to poisonous properties). *Amaryllidàceæ*. Amaryllis-like bulbs, very little known in this country; culture as for Brunsvigia.

The buphanes are large plants, with many red fls. in an umbel with 2 involucral bracts: lvs. appearing late, strap-shaped, thick: perianth tubular; segms. equal and narrow, spreading; stamens 6, exserted, attached on the throat; style thread-like, the stigma small.—Two species in Trop. and S. Afr. The fls. appear before the lvs., being as many as 200 together in a single head-like umbel, on a stout peduncle 1 ft. or less high.

dísticha, Herb. (*B. toxicària*, Herb. *Hæmánthus toxicàrius*, Thunb. *Brunsvígia toxicària*, Ker-Gawl). Bulb, 6–9 in. diam., tunicate: lvs. several, distichous, 1–2 ft. long: peduncle or scape stout (6–12 in. high) and solid, compressed, glaucous, bearing a dense umbel. B.M. 1217.—Sparingly offered. Lvs. said to be very poisonous to cattle in S. Afr.; bulb furnishes arrow poison for the natives.

ciliàris, Herb. (*Amarýllis ciliàris*, Linn. *Brunsvígia ciliàris*, Ker-Gawl. *Crossỳne ciliàris*, Salisb. *Hæmánthus ciliàris*, Linn.). Fewer shorter lvs., and shorter peduncle, bearing 50–100 dull purple fls.; may occur in choice collections. B.R. 1153.

L. H. B.

BUPHTHÁLMUM (Greek for *ox-eye*). *Compósitæ*. A genus of 7 species of European and W. Asian perennial herbs, sometimes grown in the hardy border. Heads large, with long yellow rays and imbricated involucral bracts: lvs. alternate, entire or dentate: pappus short, often connate into a corona: achenes glabrous. Showy plants of easy cult.

speciosíssimum, Ard. (*Telékia speciosíssima*). Two to 5 ft.: lvs. cordate and clasping, the upper ones oval and acuminate: heads solitary on the ends of the sts., flowering in July and later.

salicifòlium, Linn. (*B. grandiflòrum*, Linn.). Lower lvs. oblong-lanceolate, 3-nerved, somewhat pubescent and slightly serrate: fls. solitary and terminal, large.

speciòsum, Schreb. (*B. cordifòlium*, Waldst. & Kit.). Lvs. very large, cordate, coarse-serrate: fls. very large

and showy, on an upward-thickened peduncle: 3–4 ft., blooming in June and later. J.H. III. 53:187. B.M. 3466 (as *Telekia speciosa*).—The best of all, a bold free and showy perennial growing very close and making good mass-effects. L. H. B.

N. Taylor.†

BUPLEÙRUM (Greek, *ox* and *rib;* of no obvious application). *Umbellíferæ.* A genus of 75 species of weedy plants of the Old World, of which one (*B. rotundifòlium*, Linn.), is naturalized in the eastern states, and another (*B. falcàtum*, Linn.), is cult. in Japan for greens (A.G. 13:9). Lvs. simple, entire, often perfoliate: fls. umbellate mostly without an involucre except in the species below; calyx-teeth mostly none.

697. Bupleurum fruticosum.

fruticòsum, Linn. Fig. 697. Shrubby, 3–5 ft.: lvs. oblong, leathery, mucronate, sometimes persistent, usually quite sessile: fls. with a reflexed involucre, the umbels also with a set of bracts, also recurved: fr. oblong. S. Eu.—Suitable for dry, almost sterile, places.

B. cròceum, Fenzl. A showy perennial with fls. and involucral bracts bright yellow. Asia Minor.

N. Taylor.

BURBÍDGEA (after F. W. Burbidge, who discovered it in Borneo). *Zingiberàceæ.* Allied to Hedychium, but with no lateral perianth segms. and the lip reduced to a small blade. The showy orange-scarlet fls. rival cannas in brilliancy. For cult., see *Alpinia* and *Hedychium.*

nítida, Hook. f. Tender herbaceous perennial: height 2–3 ft.: rootstock creeping, matted: sts. tufted, slender: lf.-blades glossy, 4–6 in. long, eared at junction with the sheath: panicle terminal, 4–6 in. long, many-fld.; inner perianth-tube 1–1½ in. long; outer segms. 1½–2 in. long, orange-scarlet, the dorsal one shorter and more roundish than the 2 lateral ones. B.M. 6403. G.C. II. 12:401.

B. schizocheila, Hort. Dwarfer and more compact in habit than B. nitida: Lvs. dull green above, brown-red beneath: fls. orange-yellow. Malaya.

BURCHÉLLIA (W. Burchell, botanical traveler). *Rubiàceæ.* One species from S. Afr., an evergreen shrub, with opposite short-petioled lvs. and dense terminal clusters of sessile scarlet fls.: corolla tubular, bell-shaped; stamens 5, inserted in the tube: fr. a 2-celled, many-seeded berry. **B. capénsis,** R. Br., has been in the American trade, being cult. for its rich, dark foliage and brilliant fls. It is very variable, and has received several names. Three to 10 ft. Prop. by cuttings. Grown under glass. B.M. 2339 (as *B. bubalina*). R.H. 1886:420. J.H. III. 34:81. L.B.C. 7:664. B. R. 466.

BURDOCK: *Arctium.*

BURLINGTÒNIA: *Rodriguezia.*

BURNET (*Potèrium Sanguisòrba*, Linn.). A hardy rosaceous perennial, the piquant lvs. of which are sometimes used in flavoring soups and salads. The dried roots are occasionally used as a family remedy. Burnet is little known in this country as a condimental herb. It is worthy a place in the hardy border for the ornamental character of its odd-pinnate lvs. and its little heads of fls. with drooping stamens. The lfts. are very dark green, ovate and notched: sts. 1–2 ft. high, bearing oblong or globular monœcious heads. Of easiest cult., either from seeds or by division of the clumps. Native of Eu. L. H. B.

BURNING-BUSH: *Euonymus.*

BURRIÈLIA: *Baeria.*

BURSÀRIA (*Bursa*, a pouch, alluding to the shape of the pods). *Pittosporàceæ.* Two species of shrubs with white fls. in clusters; sepals, petals and stamens each 5, the petals soon withering: fr. a 2-loculed caps., in shape like that of the shepherd's purse.

spinòsa, Cav. An elegant spiny shrub or small tree, with drooping branches and pretty white fls., produced in summer: lvs. small, oblong-cuneate, alternate and nearly sessile ½–1 in. long: fls. small, lateral or terminal, mostly terminal in broad pyramidal panicles. Austral. Tasmania. B.M. 1767. Andr. Bot. Rep. 314.—Cult. in S. Calif.

BURSÈRA (Joachim Burser, a disciple of Caspar Bauhin). *Burseràceæ.* Usually tall trees, with simple or pinnately compound lvs.: fls. small, in clusters, 4–5-parted, with twice as many stamens as petals or sepals, and a 3-parted ovary containing 6 ovules: fr. a 3-parted drupe with usually only 1 seed.—About 40 species of trees in Trop. Amer. For *B. serrata*, see *Protium.*

Simarùba, Sarg. (*B. gummífera*, Jacq.). Gumbo-limbo or West Indian Birch. Lvs. odd-pinnate, with 3–5 pairs of lfts.; lfts. ovate, acute, membranous, smooth on both sides, entire, the netted veins prominent on the under side: fls. staminate and pistillate, appearing before the lvs. or as they unfold, in knotty racemes somewhat resembling those of the choke cherry: fr. a drupe, with a 3-valved succulent rind and 3–5 nuts.—A tall tree with a straight trunk and spreading head, found in Fla., Mex., and Cent. Amer. and the W. Indies. Wood very light, specific gravity when dry 30; useless even for fuel; decays very rapidly. It yields a sweet, aromatic balsam, which is used in Trop. Amer. as a medicine for internal and external application; dried, it is known in the trade as Chibou, or Cachibou resin, or Gomart resin. It is known as a hardy greenhouse plant, and thrives in a compost of loam and peat. Prop. by cuttings under glass, with bottom heat. G. T. Hastings.

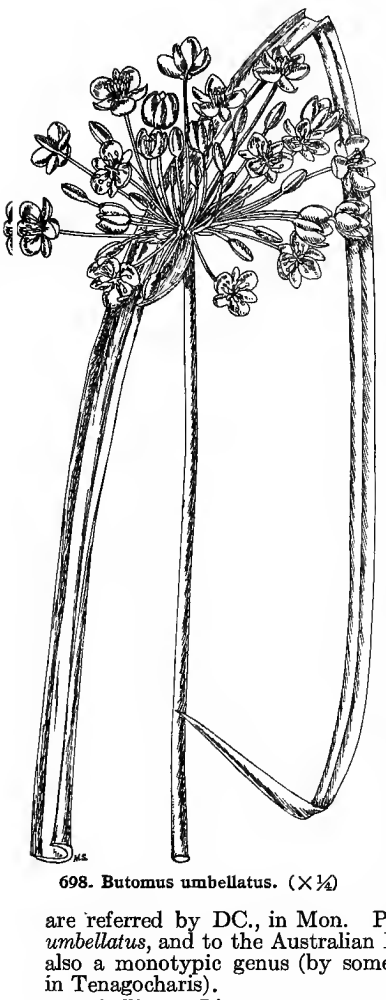
BUSH-FRUITS. A term used to designate those small-fruits that grow on woody bushes. It includes all small-fruits—as that term is used in America—excepting strawberries and cranberries. Bush-fruits is an English term, but it has been adopted in this country, notably in Card's book on "Bush-Fruits." The common bush-fruits are currants, gooseberries, raspberries, blackberries, and dewberries.

BUTCHER'S BROOM: *Sarcococca.*

BÙTEA (Earl of Bute). *Leguminòsæ.* Three or 4 species of trees or woody vines of India and China, with deep scarlet papilionaceous fls. in racemes, and pinnate lvs. In the Old World rarely grown in stoves. In this country 1 is cult. in S. Calif.

frondòsa, Roxbg. A leafy tree, yielding gum or lac: lfts. 3, roundish, pubescent beneath, the lateral ones

unsymmetrical: fls. 2 in. long, orange-crimson, very showy; stamens 9 together and 1 free. E. India and Burma. Rheede Hort. Mal. 6:16, 17.—Reaches a height of 50 ft. Inspissated juice is known as Bengal or Palas kino, or butea gum, which has astringent properties, resembling true kino. Seeds used in India as a vermifuge. The tree yields also stick-lac. The coarse, fibrous material obtained from the inner bark is used for caulking the seams of boats. Dried fls. yield a yellow or orange dye.



698. Butomus umbellatus. (×¼)

BUTNÈRIA: *Calycanthus.*

BÙTOMUS (Greek, *bous*, ox, and *temno*, to cut; the leaves too sharp for the mouths of cattle). *Butomàceæ.* Hardy perennial aquatic of easy culture in ponds.

The Butomaceæ comprises 3 genera. Butomus is allied to Alisma, but with several ovules in each carpel: perianth-segms. all prominent and colored; stamens 9; carpels 6, tapering above: lvs. sedge-like. All the species are referred by DC., in Mon. Phan., Vol. III, to *B. umbellatus*, and to the Australian Butomopsis, which is also a monotypic genus (by some, however, included in Tenagocharis).

umbellàtus, Linn. Flowering Rush. Fig. 698. Rhizome thick: lvs. 2–3 ft. long, iris-like, sheathing at the base, 3-cornered: fls. rose-colored, 25–30 in an umbel, on a long scape; sepals 3; petals 3. Summer. Eu., Asia, in still water. Prop. by division.

BUTTERCUP: Species of *Ranunculus.*

BUTTERFLY WEED: *Asclepias tuberosa.*

BUTTERNUT: *Juglans.*

BUTTERWORT: *Pinguicula.*

BUTTON-BUSH: *Cephalanthus.*

BUTTONWOOD: *Platanus.*

BÚXUS (ancient Latin name). *Buxàceæ.* Box Tree. Ornamental small trees or shrubs grown chiefly for their handsome evergreen foliage.

Leaves opposite, short-petioled, penninerved, entire, glabrous or nearly so, coriaceous: fls. monœcious, apetalous, in axillary or terminal clusters, consisting usually of 1 terminal pistillate fl., with usually 6 sepals and with a 3-celled superior ovary with 3 short styles and several lateral staminate fls. with 4 sepals and 4 stamens: fr. an obovate or nearly globular 3-pointed caps., separating into 3 valves, each containing 2 shining black seeds.—About 30 species in the mts. of Cent. and E. Asia, N. Afr., and S. Eu., also in W. India and Cent. Amer.

These are evergreen shrubs of rather slow growth, with shining, small foliage and inconspicuous flowers and fruits. *Buxus japonica* seems to be the hardiest species, and it has proved quite hardy at the Arnold Arboretum; and *B. microphylla* is of about the same hardiness, while *B. sempervirens* is somewhat tenderer; *B. balearica* and *B. Wallichiana* are still more tender. *B. sempervirens* stands pruning very well, and in the old formal gardens of Europe was formerly much used for hedges, and sometimes trimmed into the most fantastic shapes; the dwarf variety is still often planted for bordering flowerbeds. The very hard and close-grained wood is in great demand for engraving and finer turnery work.

The box tree thrives in almost any well-drained soil, and best in a partially shaded position.

Propagation is by cuttings from mature wood early in fall, kept during the winter in the cool greenhouse or under handlights in the open; in more temperate regions they may be inserted in a shady place in the open air; 4 to 6 inches is the best size for outdoor cuttings. Layers will also make good plants. The dwarf variety is usually propagated by division. In planting borders, it is essential to insert the divided plants deeply and as firmly as possible, and to give plenty of water in the beginning. Seeds are sown soon after maturity, but it requires a long time to raise plants of good size from them.

A. *Width of lvs. less than ½in.*

B. *Lvs. oval to oblong-lanceolate, broadest about or below the middle: branchlets usually slightly pubescent.*

sempérvirens, Linn. Common Box Tree. Fig. 699. Shrub or small tree, to 25 ft.: branches quadrangular: lvs. oval-oblong or oval, rarely roundish oval or lanceolate, usually obtuse, ½–1½ in. long, petioles usually pubescent: fls. in axillary clusters; staminate fls. sessile, with a central gland half as long as the calyx. S. Eu., N. Afr., Orient, China. H.W. 3, p. 29. F.E. 18 pl. 81. Gn. 55 p. 62.—Wood much used for engraving. Lvs. employed in medicine. Very variable in size, color and shape of the lvs.; some of the most commonly cult. forms are the following: Var. **arboréscens,** Linn. Fig. 700. Tall shrub or small tree: lvs. usually oval. The typical form. Var. **argéntea,** Loud. (Var. *argénteo-marginàta,* Hort.). Lvs. irregularly edged with silvery white. Var. **aùrea,** Loud. (var. *aùrea maculàta,* Baill.). Lvs. variegated with yellow or entirely yellow. Var. **marginàta,** Loud. (var. *aùrea marginàta,* Baill. and Hort.). Lvs. edged yellow. Var. **glaùca,** Koch (var. *macrophýlla glaùca,* Hort.). Lvs. oval, glaucous. Var. **rotundifòlia,** Baill. (var. *latifòlia,* Hort.). Lvs. broadly oval. Var. **Hándsworthii,** Koch. Of upright habit, with rather large dark green lvs. Var. **oleæfòlia,** Hort. Of upright habit, with oblong lvs., resembling those of the olive. Var. **élegans,** Hort. (var. *oleæfòlia élegans,* Hort.). A variegated form of the preceding variety. Var. **bullàta,** Koch. With large bullate lvs. Var. **angustifòlia,** Loud. (var. *longifòlia,* Hort., var. *salicifòlia,*

699. Buxus sempervirens. (×½) The lower spray shows the under surface.

Hort.). Shrubby: lvs. oblong-lanceolate. Var. **myrtifòlia**, Loud. Usually low: lvs. small, elliptic-oblong. Var. **rosmarinifòlia**, Baill. Low: lvs. small, linear-oblong, revolute at the margin. Var. **suffruticòsa**, Linn. (var. *nàna*, Hort.). Dwarf: lvs. small, oval or sometimes obovate; flowering clusters usually only terminal.

BB. *Lvs. usually obovate, broadest above the middle: branchlets glabrous.*

japònica, Muell. Arg. (*B. obcordàta*, Hort. *B. Fórtunei*, Hort.). Shrub, 6 ft., with spreading branches: lvs. cuneate, obovate or roundish obovate, obtuse or emarginate at the apex, ½–1¼ in. long, light green with glabrous petioles: clusters axillary; staminate fls. sessile, with a central gland as long as the calyx. China, Japan. S.I.F. 2:38.—Very distinct with its spreading slender branches and light green, lustrous foliage.

microphýlla, Sieb. & Zucc. (*B. japónica* var. *microphýlla*, Muell. Arg.). Dwarf, often prostrate shrub, quite glabrous: lvs. obovate or obovate-lanceolate, ⅓–1 in. long: clusters mostly terminal; staminate fls. sessile, with a central gland like the former. Japan.

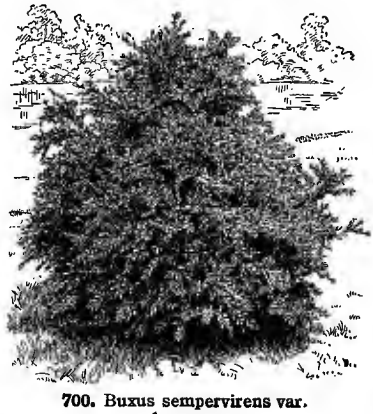
AA. *Width of lvs. ½in. or more.*

baleàrica, Willd. Shrub, 6–15 ft.: lvs. elliptic or oblong, acute or obtuse at the apex, 1–2 in. long, light green: clusters axillary; staminate fls. pedicelled. S. Spain, Balear.—Handsome shrub, but less hardy than the former.

B. californica, Lk.=Simmondsia californica.—*B. Fórtunei*, Carr. =B. longifolia.—*B. Fórtunei*, Hort.=B. japonica.—*B. Hárlandii*, Hance. Branches pubescent: lvs. narrow obovate, emarginate, ¾–1¼ in. long. China.—*B. longifòlia*, Boiss. (B. Fortunei, Carr.). Lvs. narrow-elliptic or lanceolate, 1–1¾ in. long. Orient, China.—*B. longifòlia*, Hort.=B. sempervirens var. angustifolia.—*B. Wallichiàna*, Baill. Branches pubescent: lvs. linear-elliptic, 1–2½ in. long. Himalayas.

ALFRED REHDER.

BYRSÓNIMA (name refers to use of some species in tanning, in Brazil). *Malpighiàceæ*. Perhaps 100 Trop. American trees and shrubs, frequently climbing, rarely known in cult. Lvs. opposite, thick, simple, entire, the stipules often connate: fls. white, yellow or pink, in terminal simple or branched racemes; sepals and petals 5, the former bearing a pair of glands, the latter clawed and the blades concave; stamens 10, the filaments united at base and bearded: fr. a 3-celled fleshy drupe, with bony seeds, often edible. *B. lùcida*, HBK., occurs in Fla. and W. Indies, a much-branched evergreen shrub, with fls. white turning yellowish or rose; apparently not in the trade. **B. crassifòlia**, HBK. Mex. and S., is offered in S. Calif. Shrub or small tree: lvs. ovate, tapering each way: fls. yellow in pubescent erect racemes. Said to bear the "nanche," a popular fruit of the Mexicans. This has a sour fermented taste; it is offered for sale in the markets of the west coast Mexican towns, and is eaten raw with salt, or in soups, or in stuffing for meats. The astringent bark, rich in tannin, is used medicinally.



700. Buxus sempervirens var. arborescens.

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